NOTTINGHAM UNIVERSITY

Faculty of Engineering and
Institute for Science and Society (ISS),
School of Sociology and Social Policy

DEVELOPING A FRAMEWORK FOR SUSTAINABLE MANUFACTURING OF TECHNOLOGIES IN AFRICA FOCUSING ON GHANA

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ABSTRACT

This thesis is concerned with developing a framework for the sustainable manufacturing of technologies in Sub-Saharan Africa, focusing on Ghana, for local industry. The interest here is on manufacturing and production technologies.

Drawing on the work of Clemens and Dalrymple (2005), a three-step approach emerged as an overarching methodology leading to the construction of the Ghana manufacturing of technology model (GMTM). The work of Sagasti (1992) provided the framework for its construction.

The aim here is to investigate to understand what factors account for the state of technology drawback in Ghana, so as to be able to explain them. A multidisciplinary approach was therefore required and employed. Owing to the human and cultural understanding required here, a mixed-research approach involving ethnography, grounded theory and case-study was found to be most suitable. This involved data from two rural communities, expanding to the urban areas where government officials, policy makers and heads of institutions were interviewed. The corpus of data was analysed using grounded theory and a case study of the shea butter industry provided further insights.

The findings, among other things, suggest that Ghana has no focused framework for technology manufacturing for local industry. The study noted that the cultural and ethnic division in traditional Ghana, inhibits knowledge and cultural exchange, hence, affecting the deployment and advancement of traditional technologies in the "closed" societies. This division is reflected in

the formal Ghanaian sector, which side-lines the traditional sector from development and industrialisation decision making. Government Officials and policy makers were found to be vague on technology development for local industry, but were focused on developing high-techs, like nano-technologies and science parks. The study sees this as misplaced priority.

The technology drive will require a business model, which falls outside the scope here, hence left for future work. A new concept of *development engineering* emerges from the study.

CONFERENCES AND PRESENTATIONS

Some of the conferences, seminars and presentations participated in include the following:

1. Production and Operations Management Society (POMS) International Conference at Singapore, 21 to 23 July, 2014. Theme: smart operations in a connected world.

   My presentation at the conference was titled: Testing the model for technology development framework for Ghana. This was based on the submitted conference paper titled: "A framework towards technology development in Africa in the face of demographic urban/rural paradigm drift". I presented under the panel for Technology Development.

2. The Institute for Science and Society (ISS) PhD Seminar Series Presentation, 19th of July, 2014, at the School of Sociology and Social Policy, University of Nottingham. Topic presented was: Testing the Model for Manufacturing of Technology in Ghana.

3. The Twentieth Annual SPRU DPhil Day International Conference at the University of Sussex, 7 to 8 May, 2014. The theme of the conference was, Research Challenges. Here, I was attached to the International Development Panel and presented on the challenges encountered during the course of this research. The presentation was titled, "Challenges in researching a new approach for technology development in Africa, using Ghana as case study".

4. A Leverhulme Trust Science in Public (SiP) 2013 International Conference, at the University of Nottingham,

on the theme, critical perspectives on making science public. At this conference, under the panel for, Science and the Public in African States, I presented on the topic, "Obstacles to the expansion of science and technology for socioeconomic development in Ghana".

5. Two papers have been accepted for the Third National Conference of Polytechnics in Ghana, coming up after the submission of this thesis, from the 7th to the 10th of September, 2014, at Ho Polytechnic, Ghana. The papers are to be published by the conference publication outlet.

I attended several other seminars and presentations, both at the Faculty of Engineering and the School of Sociology and Social Policy during the course of this research work.

The papers presented at the three conferences are due to be published in their individual conference publication outlets. The first being the Leverhulme Trust – Science in Public (SiP) (Making Science Public) 2013 International Conference at Nottingham, UK, the second, the SPRU DPhil Day International Conference at the University of Sussex, UK, and the third is the Production and Operations Management Society (POMS) 2014 International Summer conference at Singapore.

In addition to the conference papers, there were two publications sent to two different journals; one on, *technology development in Africa focusing on Ghana* and the other was a report on *ethnography in Ghana*. Both papers were however rejected on peer reviewing. Reasons for rejection: The earlier submission was said not to be international enough for the journal as research data was limited to Ghana only. The second submission

also was rejected on the basis that it was 'not grounded in systematic ethnographic methods such as participant observation, and intensive interviewing'. This could probably relate to the micro nature of the ethnography undertaken for this research.

However, two other papers on African technology development are being collated with other authors for submission to a special issue publication in a prospective African development journal.

Also, a paper submission has been accepted for the forthcoming 8th International Conference on African Development, organised by The Center for African Development Policy Research (CADPR) in Michigan, in the USA. The conference is set for the 14th to 16th of August, 2014, at the Western Michigan University (WMU).

DEDICATION

To the course of fighting against poverty in Africa and anywhere else the world

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ACRONYMS

AfDB	-	African Development Bank
AGI	-	Association of Ghana Industries
ASSI	-	Association of Small-Scale Industry
AU	-	African Union
BAC	-	Business Advisory Centre
BMI	-	Business Model Innovation
CEPS	-	Customs Excise and Preventive Service
Cocobod	-	Ghana Cocoa Board
CSIR	-	Council for Scientific and Industrial Research
DVLA	-	Driver and Vehicle Licensing Authority
GMTB	-	Ghana Manufacturing of Technology Board
GMTM	-	Ghana Manufacturing of Technology Model
GOPDC	-	Ghana Oil Palm Development Company
GSB	-	Ghana Standard Board
MEST	-	Ministry of Environment, Science and Technology
MoFEP	-	Ministry of Finance and Economic Planning
MoTI	-	Ministry of Trade and Industry
NBSSI	-	National Board for Small Scale Industry

NEPAD	-	New Partnership for Africa's Development
PEF	-	Private Enterprise Foundation
POMS	-	Production and Operations Management Society
STC	-	State Transport Corporation

CHAPTER ONE

1.0 BACKGROUND TO THE STUDY

1.1 Introduction

1.1.1 Research Background

Sub-Saharan Africa (Africa, henceforth) is typically described by the media and some Africanist scholars as underdeveloped or developing. Such description is further strengthened by the low economic turnout of African nations. This is shown by various economic indices published by organisations such as the World Bank, United Nations, the CIA World Factbook and other global economic interest reportages. The African economy, as shown in modern history, has never been at the forefront of global technological leadership (Austin and Headrick, 1983, Davidson, 1969, Davidson, 1991, Edgerton, 2008). This, invariably impacts on the economy, as such, it is the interest of this study to seek a means to develop the technological capability in Africa, focusing on Ghana only. Ghana will therefore be viewed sometimes under the scope of the African region, hence both may be used interchangeably when necessary.

Indeed, the economic performance of Africa is seen as attaining overall unprecedented positive growth for the first time in history (BBC-News-Africa, 2013). Even after excluding South Africa, which alone accounts for almost half of the continent's economy, Africa's growth is still poised to rise from five to six percent by the year 2014 (The-World-Bank, 2013). The registered growth and the forecast is claimed by the World Bank to have been

achieved by placing much emphasis on increasing competitiveness and creating more jobs through a strategic partnership with key development partners involved in the development of the continent.

Such spontaneous economic growth resulting from some form of capital injection into the African economy has, however, been described by some economists as fragile (Aryeetey and Fosu, 2008). The fragility is seen on the basis that the growth is dependent upon the strategic role of development partners, like the World Bank and its leverage organisations to Africa. These leverage organisations are mainly financial and political institutions such as African Development Bank (AfDB), the African Union (AU), New Partnership for Africa's Development (NEPAD) and the political leaders (The-World-Bank, 2013). The performance of the economy still remains largely dependent on the production and transaction of primary produce like unprocessed cocoa, shea nut, unrefined gold and others (Juma, 2011), which, invariably, limits the earning capability. These partnerships for development, being financial and political, seem focused mainly on using development approaches inherent in those fields of study/profession, hence, non-technical consideration.

It is, at this stage observable, how there seems to be little or no thought of incorporating an engineering consideration in the approach adopted by the international development agents. This could be seen as a display of lack of understanding of the scope of engineering applicability. Or, they take a parochial perspective and only view through their own glasses; perhaps, reckoning that economic planning is totally devoid of technical concerns, hence,

precluding an engineering contribution. It may be worth mentioning here beforehand that all economic activities rely on some form of technological device for their effective operation. For example, providing transport services will require the use of a transportation vehicle like the bus, train, etc. these are technological devices. Similarly, to produce this document, or those used by the development agents, they may need to use a computer attached to a printer, etc. Again, these all need to be manufactured. The examples are endless. This therefore points to the need for a fundamental initial consideration towards a technical input in any economic development endeavour aimed at societal material wellbeing. Persistent omission of technological consideration for the African development agenda (Lall and Pitroballi, 2002) could be seen as endangering the prospects for any meaningful lasting solution. Africa needs technology to be able to add value to its vast natural resources and primary produce. The emphasis here is for Africa to generate the technologies by itself, by its initiative. This is to debunk the mind set of relying on the conventional approach of importation of technological solutions which have no cultural connectivity (Gertler, 2004) to the specific African society, e.g. Ghana, hence, partly accounting for its eventual quick demise.

In his work, Juma (2011), took cognisance of the need for the use of technology in Africa, but like other authors, focused on the call for infrastructure (which are indeed available to a considerable extent amount, but not regularly maintained) and could not suggest how the needed technologies to build the infrastructure could be generated. The conventional methods have always been acquisition and adaptation (Lall and Kraemer-Mbula, 2005, Lall and Pitroballi, 2005) to imported technologies.

These methods have not been very suitable for the long term African development or its cultural landscape as they have persistently failed. Alternative approach to development therefore needs to be sought so as to be able to harness and add value to Africa's natural resources. And this sought for approach is being considered in the light of technology development, focusing on manufacturing or production technology capability. Indeed, because of the lack of this technology, though the continent may be thus rich;

> *Africa has almost 90% of the world's cobalt, 50% of gold, 90% of platinum, 70% of tantalite, 98% of chromium, 64% of manganese and 33% of uranium* (EconomyWatch-Content, 2010).

...yet, Africa remains the poorest continent in the world (Acemoglu and Robinson, 2010, Lall and Kraemer-Mbula, 2005, Lall and Pitroballi, 2002). That is, even after the huge influx of capital-intensive technology over several decades (Akubue, 2000) and sporadic injection of investment capital (Aryeetey and Fosu, 2008), the economy still remains fragile (ibid) and poor.

Taking into account the influx of capital-intensive technologies therefore, the fragility in the African economy cannot be attributed to a lack of the presence of technology. History shows how technologies have consistently been introduced into the continent prior to and after the era of colonisation. Clearer answers are therefore required to address Africa's technological matters.

As earlier hinted, the conventional method of reliance on capital-intensive technological influx into the developing world has not

been able to address the economic imbalance of pressing poverty (Schumacher, 1974). Neither has the alternative approach of low-end technologies expanded in the theories of Appropriate Technology (AT), such as, labour intensive, low cost, renewable, indigenous, intermediate, etc., technologies been able to achieved any widespread success in a developing economy (Edgerton, 2008). One major feature observed with the conventional approach is its seeming imposition on the local economy rather than having these technologies, whether capital-intensive, or labour-intensive, to competitively evolve culturally from the society. Indeed, they are found to be benignly "imposed" on such society as a well worked-out complete remedy package delivered to the beneficiary. Such approach treats the concerned society as exogenous to the whole planning process and implementation agenda.

On the part of the African societies, they do not seem to receive these technologies with the enthusiasm for adoption (Austin and Headrick, 1983) and subsequent cultural assimilation (Gertler, 2004) to lead to an initiative for indigenous technology development as seen in Japan and South East Asia (Bosworth and Collins, 2007, Edgerton, 2008, Jequier, 1976, Lall and Kraemer-Mbula, 2005, Lundvall B-A. and Borras, 2007). The ostensible absence of an impetus or culturally embedded enthusiasm for technological adoption and development in the African society raise a major concern in this study, hence the question to identify what factors may account for this technology drawback.

This apparent lack of self-initiative to develop indigenous technology is thus seen as partly leading to the fragility

described in the Ghana economy. This was found not to be limited to Ghana or Africa alone, but across nations of African descent like the Caribbean Islands and indeed, beyond to include the Oceania States as reflected in their economic output (The-World-Factbook-Carribean, 2013). For the case of Africa, and hence, Ghana, this study, therefore, argues against the conventional development approach modelled by the so called development agents, who view the African problem of underdevelopment from their own 'invisible ethnocentric' perspective (Chevalier et al., 1992) and obliterating the cultural representation of African rudimentary technological initiatives and their potentials for improvement. Such conventional approach, which is claimed to have evolved since the 1980s into capacity building (Barber, 1991) and found to yield disappointing results over the decades (Sachs, 1992, Sagasti, 1992), has not changed any significantly in its method. This can be observed in the [new] World Bank approach of building partnerships in Africa (The-World-Bank, 2013). This partnership approach invariably, does not give much attention to technology creation issues, but is, again, focused a lot more on provision of credit (financial assistance, i.e. spontaneous injection of capital and foreign direct investment (FDI)), which will, according to the assessment of this study, further entangle the already ailing African economy into a financial crises without any technological leverage for escape, thus, making the continent's economy even more fragile.

With this concern therefore, the focus in this study, is to seek a way to generate (to manufacture) the technologies needed by the local production industry in Africa, focusing on Ghana. The adopted means to achieving this aim here is to approach it from the *Manufacturing Engineering* perspective; to develop a

framework for sustainable manufacturing of production technologies for local production, to enable local enterprises to add value to their primary produce/resources. This approach will be culturally imbued through an overarching three-step methodological framework derived from the work of Clemens and Dalrymple, (2005) to ensure maintenance, survival, growth and its continued development. That is to say, to put in a conscious effort to address the low productivity (poverty) syndrome in Africa through a concerted mechanism of "home" technology creation (manufacturing) of production and manufacturing technologies. This is in effect seeking an engineering contribution to the already well advanced analyses and discussions of technology matters in other fields of study like sociology, economics, history and others.

This, in effect, signifies the need to join forces with other discipline areas, thus, leading to an interdisciplinary approach. This approach, among others may include the works of the technology social scientists, development economist, political economists, technology historians, industrial geographers, and other similar fields of study which are non-engineering, but for long have dominated discussion of technological matters. In other words, it could be seen as a call for engineering inclusion, to present the engineering perspective, which is technology creation for the technologically deprived society. This engineering aspect is here, tentatively, referred to as *Development Engineering*. The Development Engineering concept, however, is not the discussion in this thesis, but it is hoped that this study will provide some bases for its future development in a separate study. Thus, this thesis is focused mainly on developing a framework for the manufacturing of [production or

manufacturing technologies] for local industries in Ghana and these technologies need to be manufactured in a sustainable manner, hence, the embedded consciousness on sustainability concept. The study is however not about *sustainability*, albeit it seeks to emphasise its consciousness and application in every stage of a manufacturing/production process business model. Details of the engineering business model will be taken on as a future study, to be fully developed using the concept of business model innovation (BMI) (Girotra and Netessine, 2014) as its framework.

1.1.2 Cultural Sensitivity in the Research

Culture variance, which could be seen as the way in which a group of people in a given society (say, in an organisation, village, town or country), perceive the world, or an event and respond, differently to it from another group (Hofstede, 1984), provides a medium for discussion in this study to better understand a society. As a measure to avoid repeating the disappointing results of conventional (non-engineering) methods to development in Africa, this study employs a cultural sensitivity consciousness based on the works of Hofstede (1984 and 2011) to better understand the African (Ghanaian) society in relation to the subject matter. Here Ghana is studied as a society in relation to its cultural inclination (Wolcott, 1990) to the topic at hand that is , the sustainable manufacturing of technology.

The "cultural study" is done with the specific aim to gain an understanding of the Ghanaian society to enable a 'manufacturing of technology' narrative to be generated. The

narratives should provide a level of discussions that might be able to explain the technology underdevelopment in Ghana.

1.1.4 Ghana as the Case for Africa

This study, in its topic of manufacturing of production technologies, takes Africa at large into consideration, though focusing solely on Ghana. It may raise concerns at certain quarters, as to how Ghana could be a singular true representation of Africa. The reader may recall that within the context of this thesis, the term Africa represents sub-Saharan Africa only (see Appendix one showing map of sub-Saharan Africa and the whole of Africa in comparison), and indeed, on certain occasions, South Africa is excluded for its relatively higher technological base as compared to the rest of the continent. Though Africa may be vast and diverse, historians like, Davidson, et al., (1965) have described Africans as ethnically homogenous in their history, migration, mode of settling, environmental conditions and others, like their state of indigenous technologies and perception in interpretations.

Indeed, Ghana could be seen as being a true representation of Africa when considering such homogeneity as in similarities occurring in societal structures (Price 1975), formation of the various African nation statehood (Herbst, 1997), similarity in language diversity (Ethnologue-Languages-of-the-World, 2014), mode belief system (Gyeke, 2003 and Davidson, et al., 1965) and other common features. Also, it is common knowledge that all Africa is poor as shown by scholars like Acemoglu and Robinson (2010). This is a common feature that most generally describes Africa, especially from media reportages. More so,

African countries, like Ghana, were either colonised by one European country or the other (The-World-Factbook, n.d.). Africa could therefore be conveniently referred to as an extension of Europe, only differed by the absence of technology development, which explains the technology lag between Africa and the developed world.

The Table 1 below attempts to summarise some of the similarities from randomly selected African countries, including Ghana. The similarities used include the year of independence of the African country, the country that colonised it and the number of living languages spoken within the country. With these similarities, despite their detailed country-to-country differences, any of the African countries could be seen as a possible representation of the other, hence, Ghana, to a very large extend, could adequately be a representation of the rest of the continent.

It can be seen from the Table that the randomly selected African countries all had their independence from their various Colonial Administrators from between the late 1950s to the mid-1970s. This suggests relatively newly formed nations. And looking at the language configurations, they all represent multi-ethnic societies, with the least number of living languages spoken being twenty-one in Zimbabwe and Nigeria topping the list with five hundred and twenty-two living languages. These languages exclude their different dialects, thus, if the dialects were included, the numbers will be larger.

Table 1: Selected country comparison in Africa

African Country	Year of Independence	Country of Colonisation	Number of Living Languages
Senegal	1960	French	38
Ghana	1957	British	79
Nigeria	1960	British	522
Tanzania	1960	British	126
Mozambique	1975	Portuguese	43
Zimbabwe	1965	British	21

1.1.5 Multidisciplinary Nature of the Research

In Ghana, efforts have been made by successive government regimes since independence to industrialise the economy (Government of Ghana, 2010, The-Republic-of-Ghana, 2011, Nkrumah, 1962). Some of the development models used include the adoption of the Dependency Theory (Ahiakpor, 1985), the Free Zone Board, Pioneer Industries and Company Act, Capital Incentive Act, tax holidays and other measures (Lall and Pitroballi, 2002) and others like systematic capital injection (Aryeetey and Fosu, 2008). These measures, however did not

result in any significant response from the manufacturing sector (Lall and Pitroballi, 2002, The-Republic-of-Ghana, 2011). On account of such persistent unsuccessful attempts by Ghana, a feature common to other African countries, it therefore became necessary to seek a pragmatic approach to the situation.

To understand the situation therefore for the pragmatic solution, a multidisciplinary approach (Sachs, 1992) was adopted for the epistemological and inductive nature of this research (Bernard, 2013, Bryman, 2012). As such, a multiplicity of research paradigms was considered. This led to using a realist/pragmatist/constructivist mixed research methodological framework involving ethnography, grounded theory and case-study, i.e. ethnographic-grounded-theory-case-study (Bernard, 2013, Cohen and Manion, 1994, Corbin and Strauss, 2008, Mackenzie and Knipe, 2006, Wolcott, 1990, Yin, 1981, Zainal, 2007).

Micro-ethnography (Wolcott, 1990), was used for data collection from two rural communities in Ghana. In addition to the rural experience, government officials, policy makers, heads of government departments and academic institutions in the urban areas were interviewed. Company executives from three different companies were also interviewed along with three business owners, of which one declined taking the interview for reasons later discussed in the thesis.

The principles of grounded theory, using the Straussian version, (Corbin and Strauss, 2008, Thai et al., 2012) was used, for its robustness, to analyse the corpus of qualitative data collected from the ethnographic fieldwork.

A case study (Yin, 1984, Zainal, 2007) of the shea butter industry was conducted to further understand a specific case of the Ghanaian scenario in relation to attitudes toward technology creation.

A framework for sustainable technology development in Ghana, tentatively called, the Ghana Manufacturing of Technology Model (GMTM) and simply referred to as 'The Model', was developed based on the above three-step procedure. Here, the term, framework, is used to refer to the structure or principles on which an argument or a system is built. Its usage is therefore generic as will be seen used for different frameworks occurring in the thesis. 'The Model', on the other hand, is used with specific reference to the ensuing model (or system) that is derived from the framework under discussion. The work of Sagasti (1992) was used as the generic framework for the construction of The Model. This model will consist of a number of components, one of which will serve as its brain, here called 'The Board'. The Board is here to be known tentatively as the Ghana Manufacturing of Technology Board (GMTB). The three-step approach identified the Ghana Cocoa Board (Cocobod) as its exemplary artefact to use as the template on which to model the manufacturing system. It is perceived that the model could be adopted for possible application in other African countries.

1.1.6 Summary to the Research Background

In summary, this study highlights the fragility in the African economy, despite the registered positive growth rate and attributes this fragility to the low level of technology embedded in the African cultural society. The study highlighted the

inappropriateness of the conventional methods of addressing the African plight of technological needs. As an alternative to the conventional methods, the study adopted a culture-centred three-step methodological approach to development; this, involving studying the culture of the concerned society, identifying a success project and modelling it for the intended development plan alternatively called the SIM approach (see sub-Subsection 1.1.3 above). To do this, a practicable mixed research methodology was employed for data collection, analyses and presentation of constructed narratives. The ensued narratives led to the development framework of Ghana Manufacturing of Technology Model (GMTM).

1.2 Research Rationale

As earlier indicated in the introduction, the African problem of technology underdevelopment is describable as chronic and endemic (Austin and Headrick, 1983) despite efforts by National Governments, the International Community (Akubue, 2000) and its Development Agents. The problem of low productivity, due to a lack of technology development still persists (Acemoglu and Robinson, 2010, Lall and Pitroballi, 2002). The cause of the lack of technology development itself poses much challenge to scholars and researchers alike. As no tangible explanation has yet been found by this study from existing literature, the interest here is therefore to identify the factors that are contributing to (or accounting for) the drawback. This is because, previous efforts to address the African problem were in many instances based on speculations and assumptions, as can be seen from the work of Austin and Headrick (1983). The authors and other historians had to rely on speculations due to a lack of written

historical records on the part of Africans (Austin and Headrick, 1983, Davidson et al., 1965). Also, most of the scholars researching and writing on African matters were mostly non-Africans who mainly drew their conclusions ethnocentrically (Chevalier et al., 1992), hence, not fully representing the real situation on the ground, thus, yielded disappointing results (Sachs, 1992, Sagasti, 1992). In the light of such gap, this study perceives the disappointing results could be blamed on the non-inclusion of the African perspective. This is to say, an omission of the cultural content of the recipient society.

Owing to the previous disappointing results therefore, what this study hopes to do differently is to avoid arriving at conclusions obtained from parochial, assumptive and speculative stance, and rather move forward to establish a position based on firsthand knowledge gathered from the ground. This study therefore, intends to elucidate on the subject by eliciting narratives which reflect, as much as possible, the perspectives of natives, locals and residents of the Ghanaian society. It is hoped that such an approach as this will lead to a better understanding of the Ghanaian (African) scenario, thus, serving as a means to: formulate, create, devise, propose, a mechanism, structure or framework that will be most suited for a development project in Africa, here, the focus being on sustainable technology creation.

1.2.1 The Need for Manufacturing of Technology in Ghana

The issue of underdevelopment in Africa, has, historically been approached in different ways. Some of the approaches conventionally used towards the industrialisation of the economy

include importation of high-tech, import substitution, free zone board, etc. These different approaches and others have been in use, for example, in Ghana since before and after the colonisation era to date and have generally been described by authors as leading to disappointing results (see Section 1.1 of this thesis). These approaches have been in use as far as history can recall, but none of them has been able to transform any of the African nations into economic and technologically prosperous society.

Owing to the persistent failures of conventional methods to addressing the African problem (Barclays, 2010; Sachs, 1992; Portes, 1976) and seeing that Africa has consistently been noted as resistant to technical change all through history (Edgerton, 2008; Austin and Heardrick, 1983), it has become imperative to confront the challenge head-on with a different approach. Here, the approach considered is technology development (i.e. the manufacturing of technologies). It has been pointed out in the introduction of this thesis that the issue of technology development for Africa has been avoided by International Development Agents and indeed, by the African Nations themselves. In paradox, technology is required in all stages and forms of production and it is technology that Africa lacks, yet, it receives little or no attention as the fundamental factor for development (Grossman, 1994). Since all technologies cannot be developed at the same time, this thesis therefore focuses on seeking a means to manufacture some of the needed technologies, hence, the emphasis on developing a framework for manufacturing technologies or production technologies for local industry.

Looking at an alternative, for example; adopting a service centred approach to development will at the long run require the use of technologies. The service industry relies on technology to effectively deliver their services (Edgerton, 2008). That is to say, in providing, for example, transport services, there will be the use of transportation vehicles (trains, buses, cars, etc.), or providing communication services will need the use of telephones or/and computers. Whichever way it is looked at, technology plays the key role, and all these technologies will need to be manufactured.

Africa has always relied on importation of its technological solutions, but it has remained poor ever since. That on its own should points to the unsuitability in the method used. Importation of all ones technologies from different cultures have been found to be problematic as shown by Gertler (2004) and could eventually lead to external cultural impact as the imported products will invariably reflect the cultures of the producer-society. Therefore, Ghana manufacturing some its technologies, in the long term, creates a future of hope for cultural preservation in its society, reverses the African history of technology lag, create wealth for its people and eventually contribute more meaningfully to global economy.

1.3 Research Question

In view of the above rational, the research is guided by the attempt to answer the question as to; what factors account for the state of technological drawback in Africa focusing on Ghana? The research question presented here demands plausible answers obtainable from an understanding of the perspectives of the concerned society.

1.4 Aim

The aim of this research is to develop a framework for the sustainable manufacturing of manufacturing and production technology in Ghana for local industry. As earlier indicated, Ghana has made several efforts to industrialise its economy, but all have failed. It is observed that the various efforts lacked dedicated framework of operation. They were also found not to incorporate an understanding and implementation of local knowledge and cultural interpretations. In fact, the previous approaches do not display concerted attempts to generate the needed technologies, but simply trusted and relied on seeking state-of-the-art technologies imported from other cultural setting. These technologies become obsolete and a vicious cycle is formed. The framework to be developed here is aimed at addressing these lapses.

1.5 Objectives

The objectives in this research are to:

i. Study the Ghanaian society for its cultural interpretation in relation to manufacturing of its technologies for local production so as to understand the phenomenon of its technological lag.

ii. Use the understanding gained to construct cogent narratives capable of satisfactorily explaining what factors account for the drawback state of technological development in the Ghanaian society.

iii. Draw upon the narratives generated from data to apply on a case study of shea butter production in Northern Ghana.

iv. Develop a model for Ghana to sustainably manufacture some of its needed production/manufacturing technologies for local industry for value-addition to traditional primary produce.

1.6 Overarching Methodology

The history of unsuccessful attempts by Ghana's various government regimes to industrialise the economy is indeed a feature common to other African nations and a matter of serious concern in this study. It therefore calls for much attention. In this regard therefore, this study, drawing on the work of Clemens and Dalrymple (2005), considered it necessary to first establish an in-depth understanding of the Ghanaian society by mapping out its *rhythm* and synchronise it with the development

intent. This is to initiate a generic project implementation framework deemed suitable for application in a developing society of mixed cultures. The framework could be developed further in separate study elsewhere; however, for the purpose of using it in this study as the overarching methodology, its conceived basic principles will here be discussed briefly and shown how it will be applied for the subject matter of this study, i.e. technology manufacturing.

The overarching methodology was actually inspired by examining the development models of selected countries like Germany, US, China and Japan (see Section 4.3 of this thesis), who successfully assimilated the technologies transferred from England into their cultures and further developed on them. Comparing them to the Ghanaian setting however, revealed one major feature that differentiated them from Ghana; this being of a cultural connotation.

For example; while Germany and the rest of the highly advance countries are mainly monocultural (to a certain degree in retrospect to Ghana), Ghana was found to be highly multicultural and indeed, ethnically oriented. This difference in monoculturalism and multiculturalism could go a long way to explain the persistent demise of the industrialisation efforts in Ghana, and more so, the difference suggests that the model these countries used to assimilate the technologies into their cultures to eventually create their technological base may not be readily applicable in Ghana due to the same reason of cultural disparity stated.

On account of the complexity of the Ghanaian multicultural setting (see Section 2.3 to 2.4 of this thesis), a feature which is

absent from the modelling countries, an approach needs to be sought that will allow retaining the state of the cultural mix, at the same time, infuse technology development into the lattice structure of the society. In this regard, this study finds the work of Clemens and Dalrymple (2005) on "rhythm" to be very useful.

There, the authors, from their Business Management background in seeking an approach for business leadership, demonstrated that rhythm is the beat in everything. They opine that, 'every individual has a rhythm, a customer has a rhythm, a client has a rhythm... ...an organisation has a rhythm, this whole world has a rhythm' (Clemens and Dalrymple 2005; pp 93-94). Everyone, every nation and everything has got its own peculiar rhythm and that is what accounts for the uniqueness anyone possesses (ibid). Indeed, the authors showed that, it is when different rhythms are brought together in the right note that an orchestra is formed. This understanding is further conveyed by the authors who identified a recurring pattern of behaviour even in rhythms with conflicting tempos. The task here is how to synchronise different rhythms into a beat, i.e. a set objective.

According to the authors, 'the process by which different rhythms fall into synchronization with each other and then work in a parallel manner' is called *entrainment* (Clemens and Dalrymple 2005)-(pg. 99). And when, for example, everyone on a team operates at a pace that fits a situation, that is, when the tempo of everyone's rhythm is synchronised towards an objective, *tempo-entrainment* is said to occur. This, to a very large extend, accounts for the seemingly "effortless" input leading success of a winning team.

Thus, the authors argue that, the manner in which different incoming rhythms converge with the organisational rhythm determines the success or failure of that business entity. And it is the knowledge of the power of *entrainment* that could be used to create new rhythms to synchronise with existing ones to set a new pace or a new definition.

Therefore, applying the power of entrainment in this study, the Ghanaian society is studied to map out its natural cultural rhythm. The intention here is to synchronise the rhythm of the development intent (manufacturing of technology) with this natural rhythm of the Ghanaian society, thereby, creating a new rhythm to synchronise with the culture of the society. it has become imperative to seek such cultural synchronisation approach to ensure the implementation of any development intent is not viewed as an external force devoid of local content or marginalisation of recipient cultures and traditions.

This synchronisation objective in effect, led to the development of the three-step overarching methodological approach developed in this study (see 1.6.2 below). The generic nature of the methodology allows it to be applicable to almost any project intended to be implemented in Africa, or a society of mixed cultures like Ghana.

1.6.1 Critical Perspective of the Rhythm Concept

The subject of application of rhythm as a sine qua non to success in business leadership as shown by Clemens and Dalrymple (2005) may be intriguing, as seen, but the authors themselves admit that 'setting an effective rhythm can be tricky' (ibid; pg. 97). The difficulty there is, like in a musical note, in an event

where any contributing factor (actor or player) introduces a wrong key; the rhythm of the beat could be put into disarray. This could mean fatal blow to an organisation, or, in the worst scenario, a total collapse of a "business" entity and a collapse of a system of operation.

Application of the rhythm concept will require close coordination, like a conductor of an orchestra, with the full participation of constituent members in full focus. Achieving such in a real life situation may, on certain occasions, be described as utopian expectation. This in particular, being considered for application in the context of a developing country like Ghana, where the issues of bureaucratic processes are deemed to be highly problematic (Price, 1975).

Moreover, the anticipation of the rhythmic concept as a total solution or easy to implement philosophy could be misleading in the sense that the probable outcomes cannot be determined from start. This is partly because there cannot be set out rules or guidelines regarding its mode of application as every situation may differ from the other. The non-standardisation feature inherent in the concept leaves its implementation almost entirely to the discretion of the leading actor, or decision makers. The outcome of a possible failure or backlash cannot be overruled, hence, the need for support mechanisms.

However, one area of assurance available to the concept, when viewed as an audience to an orchestra concert is that, the conductor most probably would have rehearsed and knows what he is doing from a background of vast knowledge and experience. That should be nature of the leading team, but it may be agreed here that such a team should be expensive to

constitute and retain seeing the global competition in the business world. So, though the concept may pose difficulties and ridicules, it calls for professionalism as a vital tool to highly probable success.

1.6.2 The Three-Step Methodological Approach

The methodological framework to this effect of following the above rhythm concept is presented as a plausible guideline for the implementation of projects in a developing society with a mixed cultural background like Ghana. This approach was indeed developed as an alternative to the conventional approaches used by both the International Community and National Governments to project implementation in Africa. Authors have shown how the conventional approaches of capital injection and importation of high-tech state-of-the-art technological solutions have persistently yielded disappointing results (Sachs, 1992, Sagasti, 1992, Barclay, 2010) to resolving the economic or technological needs of developing countries (Schumacher, 1974). Though, the application of this new three-step methodology relies solely on data obtained from Ghana, it is however perceived to be of relevance to other developing countries, in Africa and beyond, especially those societies with similar cultural milieu as Ghana (see Section 1.1.4 of this thesis).

Also, although this methodological approach for development is primarily concerned with the development of sustainable manufacturing of technology for the local manufacturing or production industry in Ghana, its application is however perceived to encompass other development concerns or projects for Africa, hence, its generic nature.

In simple terms, the principle of this new methodological approach involves a three-step procedure to map out the rhythm of the society and to synchronise the development intent with it. The approach may therefore be summarised as follows:

i. Study the culture of the society in question and any other aspects of it that may be of (useful) interest to the development intent. That is, to map out the cultural rhythm of the concerned society.

ii. Identify a relevant success 'project' of that society. This should be a project which is socially integrated and culturally assimilated (totally absorbed) for a sense of ownership, belonging and participation. Note to observe the failures (difficulties) associated with this identified success project.

iii. Model that project as a template for the development project intended. In the case of this study, the project of intent is the manufacturing of manufacturing or production technology.

This three-step approach may also be referred to as the SIM approach, where SIM stands for: study, identify and model. These are the first letters of the first words of each step.

Applying the methodology to this project, the Ghanaian society was studied to understand its cultural inclination (see Chapter Two and Chapter Six of this thesis) in line with the subject under discussion, i.e. manufacturing of technology. The study identified the Ghana Cocoa Board (Cocobod) as the most suitable success story in Ghana's history (see Section 2.4.2 of this thesis). Cocobod was therefore used as the template to model the

manufacturing of technology intent for Ghana (see Section 7.3 of this thesis).

1.7 Breakdown of Thesis Chapters

This subsection provides the chapter layout of the thesis.

Chapter One attempts to provide a concise background of the whole thesis. It includes the aim and objectives of the research and the guiding research question.

Chapter Two begins the theoretical framework on which the research is built. It begins by providing an initial grounding of the subject of culture to serve as the basis to explore the Ghanaian society through literature. The aim here is to establish a level of theoretical grounding for a common understanding in the ensuing discussion in the thesis.

Chapter Three reviews further literature on the role of institutions towards a system of manufacturing of technology in the context of a developing society. It covers mainly the work of scholars in such areas as appropriate technologies, development economics, national innovations systems and development planning.

Chapter Four, still a theoretical framework from literature review, broadens the literature exploration to look at the perspectives of other fields of study in relation to technology. Some of these fields include mainly the social sciences, history, economics, geography and engineering. Finding no offshoot in engineering dealing specifically with technology creation/development for technologically deprived societies, the chapter goes on to argue

for the relevance of manufacturing of technology, placing emphasis on the application of the sustainability concept.

Chapter Five focuses on the research strategy for a research methodology, reviewing literature on research paradigms so as to come to a clear decision on which paradigm, paradigm mix or methodology mix would be the most suitable to address the research question. A mixed research methodology of ethnography, grounded theory and case study was arrived at as the most suitable approach for this study.

Chapter Six, using the chosen mixed research methodology, presents a summary of ethnography in Ghana and constructs the relevant narratives from emerging patterns from data, as the working theory. The Straussian version of grounded theory was used. The chapter also contains a case study focused on the shea butter industry.

Chapter Seven therefore goes on to fulfil the aim of the research, that is, to develop the framework for the sustainable manufacturing of technology in Ghana for local industry with applicability to other African countries. The framework stands as a business model using the success story of the Ghana Cocoa Board (Cocobod) as a template for the model.

The Conclusion Chapter Eight provides the summary of some key issues in the thesis. The concluding remarks, affirm the business model to strengthen the private sector for production and manufacturing. Finally the Conclusion Chapter and an outline of areas requiring further study were given followed by the References and Appendices.

CHAPTER TWO

2.0 A THEORETICAL REVIEW OF AFRICA FOCUSING ON THE GHANAIAN SOCIETY

2.1 Introduction

Africa is so poor, yet so rich (BBC-News-Channel, 2009). Indeed, why is Africa so poor, yet so rich? The complete answer may not be provided here, but this sets the search, as much as possible, to theoretically unravel the mystery of this long standing question. According to some Africanist authors, Africans' way of thinking and reasoning differ in many respects from the dominant international approach. This is despite the generations of western influence in the continent, Africans' decisions to problem solving are based on traditional concepts, which have fallen out of time with modernisation (Haverkort et al., 2002). Thinking among Africans range from traditional to modern (ibid), with the traditional aspect almost completely neglected to be incorporated into the modernisation agenda.

This chapter, in contributing to addressing the hanging question, will serve as a starting point, an expository discussion on the Ghanaian society looking at its cultural, historical, political and economic descriptions. It will attempt to bring to focus what it considers as the main features of Ghana's overall makeup relevant to the subject of the thesis – *sustainable technology manufacturing in Ghana* – by setting a common ground of understanding of the Ghanaian society; its formation into a nation-state. In so doing, the chapter will attempt to elucidate what may be considered as the strength or the bedrock of a

society in terms of culture and value, and indeed, what constitutes value; if the value of a culture could amount to its impetus to survival and development.

The reason for looking at the history is to use the past to understand the present and wisely project into the future.

The historic events in Ghana and interactions among the actors would be viewed under the spotlight of *acceptance* and *rejection* (July 1966). The actors here, both *natives* (living locally and aboard) and *invaders* (slave masters – Arabs and Europeans – and colonisers) seen as factions, set the scene that helped shape the history (Lloyd 1969) and the country, Ghana, as we have it today.

Acceptance or *rejection* becomes important in this case as it sets the bounds and scope for interactions between actors of the two factions. It is the interactions that determine what activity, action or reaction to put forward. For example, an action to be taken could mean any of the following: to trade, invade, sign a treaty, migrate, retreat, etc., (Davidson 1965). This would be highly dependent on how the parties *accepted* or *rejected* the terms and contents of the interactions. Factors controlling the level of *acceptance* or *rejection* would depend on the level of confidence, strength, capability, resolution, understanding, social cohesion, amount of information, aspiration, foresight etc., a particular group or society may possess, as assets based on their values and material culture (Vannini, 2009). It is with this understanding that this chapter is being constructed. These may be explained from the perspective of *cultural* interpretations, as to why groups of people act the way they do, showing different

behaviours when confronted with the same issue under similar organisation or societal setting.

Hence, as a tool for discussion and analysis, Hofstede's model of cultural dimensions (Hofstede, 1984, Hofstede, 2011) will be used as a framework.

Following this expansion therefore, the Ghanaian society is discussed under his model to see if Hofstede's stipulated dimensions can satisfactorily explain Ghana's disposition in relation to its *technology drawback*. That is to say, it is the aim of this chapter to critically assess the Hofstede model if it presents sufficient scope in dimensions and property to analyse the drawback state of technology development in Ghana and Africa at large.

In this discussion, the term Ghana may be used within the wider context of the African society. The term Africa, as earlier indicated, refers only to Sub-Saharan African (SSA) countries, and in this particular context, it may be considered to exclude South Africa due to its relatively high technological attainment. Also, making reference to the West, is not, in this study, limited to Europe only, but used to represent all industrialised countries except otherwise stated.

It may also be worth mentioning here that the use of the term Ghana in this text is not referring to the Ancient Ghana Empire, but current Ghana. Any such reference to the ancient empire will be indicated as such.

2.2 Culture as the Driver of Society

Culture, the unwritten rules found in every human grouping, such as the work place or society in general can tell a lot about the people who constitute that grouping (Hofstede, 2013). Indeed Hofstede, the social psychologist professor, realising the complex front cultural variances presents on the same issue at different places, used its traits to outline this descriptive notion of *cultural dimensions*. In his work, Hofstede found that, culture varied from place to place (country to country) and it accounted for the way people think and react differently to the same set of rules within the same, for example, [multinational] organisation at home and abroad.

Hofstede's work was informed by the non-universality of organisational theories applied to different groups of people in a work place situation or within the wider human society. Thus, Hofstede in stating that, 'culture is reflected in the meanings people attach to various aspects of their life; their way of looking at the world... ...and how they react to its challenges', suggests that culture leads to a value system, which is consciously or unconsciously adhered to within that social grouping.

For an effective discussion, it may be helpful to have a common understanding of what culture is. Authors on the topic have repeatedly stated in various literatures the difficulty they are confronted with in coming to a single definition for culture. Several definitions therefore exist, often depending on the area of cultural interest the author may have. According to some scholars, culture is placed under two broad categories (Adam and Cohen, 2009); one group of definition sees culture as the search for meaning, whereas other definitions focus on

information or knowledge. The former has to do with values, morals, and the latter is considered to relate to artefacts of culture, looking at its evolution in the use of tools. The authors observed that, what is called culture is influenced by who studies it. In other words, its understanding is subjective to the observer's perception, hence, its interpretation. Yet within such limitation, the existence of a commonality in behaviours within the setting of a particular society may be conclusive. This is what is often alluded to as the culture of the people and it appears this is where Hofstede is coming from.

Owing to the divergent views among authors, the understanding of culture generated in this study in conformity with the scholars will be taken as; a *set of commonalities in perception, beliefs, understanding, and approach to accepted ways of behaviour in a particular organization or among a group of people – culture as behaviour*. Authors at least agree on one point, that culture is variedly defined and actually problematic due to its social and historical reality of unevenness (Hall, 1980), which makes its study even more relevant.

Hofstede himself defined culture as 'a collective programming of the mind, which distinguishes the members of one group or society from those of another'. These definitions, invariably point to the conclusion, on one part, that no group of people could be together without exhibiting an identical pattern of behaviours peculiar to them – their culture – i.e. the indispensability of culture. On the other part, culture signifies the value trend on which culture itself is dependent, in other words, culture evolves.

Value, as a symbol of *cultural reality* underpins the driving relevance in constructing, structuring and restructuring of the

anecdote playing undertone (due to its nature of unwritten rules (Hofstede 2013)) to define, the constitution of a class (not a class as in social hierarchy, but class as in collection of people) in fulfilling its objective. The objective of a collection of people could be defined as; survival, competition, wealth aggrandisement, power dominance, spiritual attainment and many more. What stands out as value becomes an object for debate and possible contention. This is because; the detailed constituents of value may differ from one culture to another.

Values, as suggested earlier, are of universal applicability and not static, especially when weighed against human needs (Gerson, 1985) or changing objectives. The means to achieving *aimed objectives* draws in attention from various quarters, for example, of a production system. In his book, *Inventing Popular Culture*, Storey *(2003)* debunks the political economist's notion of culture [its studies] as being uncritical on economic issues of consumption seeing that, cultures are structured unequally, that is, when measured in terms of 'market power' (Storey, 2003). Storey points to the significance of the presence of culture, here to be understood as the determining force for human activities, as it is people who operate within such structures (in a collective mode) based on their values which invariably determines the value of an occurrence. Having said that though, placing a sole reliance on *value* as a 'concept' of discourse in cultural supposition is considered inadequate as contested by the work of Swiddler (1986), who argued that values do not shape action by defining its ends, but rather fine-tune the regulation of action within established ways of life.

Albeit, variances in cultures make each distinct to the group it identifies or tries to define and this places a premium on *taste* and ability to *access* to the tastes (Storey, 2003), which may define the characteristics it presents for any collection of peoples. It may be understood here that it is the *tastes* and *access* that draw the boundary as to what constitutes the reality of *value* and the level of *desirability* within a cultural group. For example, one may ask of a particular group; do they have a vivid choice between the *value* (i.e. cultural value) they claim to align with and the 'product' being marketed, especially when weighed against their desires, needs, wants, and aspirations. Consequently, it is this variance of the quest for 'access' that makes Hofstede's work relevant to this study, as it also attracts a wide range of applications (Tang and Koveos, 2008).

It should however be noted here that this work is not about cultures, but aims to use Hofstede's model of cultural dimensions as a basis for discussion and analysis. This is not to assume that the issues of *technology drawback*, as in the case of Ghana, is solely influenced and dictated by cultural factors. It may be worth stating here, as can be deduced from an author that culture in itself is formed depending on its determining factors (Harvey, 1997); such factors could be environment, economic status, level of acquired knowledge, determination and aspiration and others. Thus, cultures, like circumstances, do change over time. Indeed, the identified cultural dimensions account only for a small part of the differences in cultural systems around the world (Hofstede, 2011, Minkov and Hofstede, 2011).

2.2.1 Critical Perspective to Cultural Dimensions

There has been much western influence on Ghanaian society since the periods of early contact with Europeans, the slave trade and subsequently colonial and post-colonial regimes (Fage, 1959, Warner, 1960, Akyeampong, 2001, Davidson, 1969, Davidson, 1992). The new turn in lifestyle, symbolising modernism, seems to have higher attraction for the people, influencing the Ghanaian society to determine its course of direction. The *acceptance* of this influence as a seems to serve as the underlying rule "conditioning" the Ghanaian mindset to perceive the western lifestyle of commercialisation, aggrandisement, comfort in living, materiality (Vannini, 2009), etc. as the quintessence of human existence. This study sees this occurrence to result in the Ghanaian society yielding to the ideals and values of the external influence without giving much consideration as to what accounts for their success in *technology creation* which helps sustain their lifestyle.

The question that comes up is; is it the current *individualistic* cultural orientation of the west that created the success of its technological advancement or is it the advances in technology that have rather shaped their current cultural orientation from communality (Downs, 2010) to individualism (Hofstede, 1984)? The latter seems to be the case when trying to assess what, for example, the British society looked like before the period of the industrial revolution as shown by the work of Downs (2010). The inevitable question therefore is; where do the "prompts" come from to make the technologies they made? Is it motivation to over the challenges of nature, such as extreme weather condition, epidemic or some natural disaster, or is it from some

historical heritage? The search for the "prompts" seems to go beyond the scope of this study.

The impetus is very much desirable for this research work. However, that does not mean a call for cultural change in Ghana, as was previously mentioned, culture in itself is not static, it is determined by its own 'molten' underlying factors. Culture is therefore seen as drifting as circumstances change, hence constantly shaping and reshaping itself.

Cultural disposition alone, therefore, does not by itself seem able to account completely for social development in the light of industrial growth. This is readily observable from Hofstede's work (1984 and 2011), in which, by and large, contrasting the components in the dimensions for cultural features in resemblance to a developing society, are likewise identifiably present in the industrialised countries. Take for instance, as given in one of his examples, the dimension of *individualism verses collectivism*; Britain scores high on *individualism* as compared to Norway or Sweden both scoring higher on collectivism. Collectivism, as in communality, is a typical feature of the African, hence Ghanaian traditional setting (Davidson, et al. 1965).

Therefore, cultural orientation may not be taken as the absolute determining factor for technology creation, advancement, etc., neither should its change be seen (within the context of this study) as a sign for attainment of technological growth. For an enhanced discussion therefore, it has become necessary to attempt to understand the Ghanaian society in relation to technology creation aimed at economic purposes looking at its cultural orientation. It is however cautioned here that technology

does not by itself necessarily lead to economic growth. Indeed, it was noted that there was slower growth rate registered during the period of industrial revolution in England (Edgerton, 2008), despite the then superiority of its technologies.

2.3 Historical Perspective of the Ghanaian Society

Describing the Ghanaian society from its historical position will hopefully give better clarity to the cultural disposition discussed earlier. In this subsection therefore, attempts will be made to highlight some of the salient events that stand out as landmarks in the landscape of the Ghanaian history for this subject of discussion.

Ghana, though born in 1957 as the first independent country in Africa, it holds a much earlier history. It was formerly called the Gold Coast, a name coined by the first set of Europeans, the Portuguese, who first arrived on the coast of the Gulf of Guinea in 1471 (Britannica.com, 2013). There, they found so much gold and chose to build their first castle at *Elmina* (Elmina castle) in the year 1482 (ibid).

In a display of power struggle and scramble for Africa by the Europeans (Fage, 1969, Griffiths, 1986) driven by a *desire* for wealth (cultural value), which is the economic sufficiency in Europe (July, 1968), the Portuguese were overpowered [and overthrown] by the Dutch in 1637. The Dutch also subsequently lost their ground to the British in 1872, and in 1874 Britain proclaimed the coastal areas of the then Gold Coast a crown colony.

The "invasion" of the foreign powers from even before the fifteenth century, first by the Arabs, and culminating into its crystallised form of colonisation, was not totally protested against (not *rejected*) by all quarters of the inhabitants. In fact, it actually received much *acceptance* from the locals and the traditional rulers as shown by the work of Arhin (1990) and Kimbel (1963). The *Fanti People, for example,* benefited from the occupation; it protected them against their more powerful *Asanti* neighbours. This *acceptance* may be seen as the shaping of Ghana from its core traditional settings to its current ethnic multi-cultural mix of today, resulting in cultural changes.

In fact, the land currently occupied by the present-day Ghana, has evidence of human contact as far back as 10,000 B.C. (Britannica.com, 2013) along the River Oti. There is also evidence of Stone Age civilization near Accra and Iron Age activities at Tema a period between 400BC to 100BC respectively. It is however not clear who the inhabitants were at that time.

Modern history has it that the current inhabitants of Ghana began to appear on the land from around 1200 AD, first by the Guans (Dickson, 1969, Fage, 1959) who began their migrations down the Volta Basin from Gonja (the Northern stream) toward the Gulf of Guinea. From this time on marked the arrival of other migrating tribal groups, continuing a movement pattern which began from time immemorial across Africa (Arhin, 1978). With over a thousand ethnic groups in the continent, many of them have similar origins or historic relationships (Haverkort et al., 2002), hence, a common African feature.

However, a renowned Ghanaian historian, disputes such narrative, denying the migration saga and claiming some tribes

have always occupied their current location (Boahen, 1966). Such assertion will not be followed further by this study as it is outside the current scope of discussion. However, scholars, on a wider scale attest to varying levels of emigration and immigration in Africa (Anarfi et al., 2003).

The tribal groups are differentiated mainly by their language and different cultures, arriving at various time periods, as given by other narratives. They arrive to conquer new lands for themselves from the Aborigines or to occupy virgin lands. Ghanaian oral tradition often refers to these aborigines to be dwarfs and other forms of humans and spirits (Davidson et al., 1965). As written documents were not available, historians had to rely on archaeological findings and oral tradition to trace the history of Africa. In fact, it has been noted by historians that West Africans had no knowledge of the art and use of writing and of written records (Davidson et al., 1965).

Thus, the build-up of the present location, Ghana, did not start with written records, but efforts were made to reconstruct the past from traditions and cultures as in songs and storytelling of the legendary past through oral tradition. The level of accuracy of oral tradition however, would require its own empirical study for verification. But history generally seems to agree with the oral tradition of West African's ancestral migration from elsewhere into its current location, as in the case of Ghana under discussion. The work of Davidson (1991) points out that:

> *From the plainland of the green Sahara, as it then was, black peoples multiplied and spread, eventually creating the great civilisations of Paranoiac Egypt and the Nile Valley* (Davidson, 1991)-(pg. 3).

From these points of civilisation, migration further would have taken place as kingdoms would normally rise and fall, expelling the losers, (Akyeampong, 2001). This indeed conforms to the oral tradition of the Ewe people's migration legends (Charles and Mamattah, 1978).

On the issue of African migration from the Nile Valley, a number of African tribes claim their ancestry from Ancient Egypt. Such tribes include the Ewe people currently occupying the South-Eastern parts of Ghana, spreading across to Southern Togo, Benin Republic and parts of Western Nigeria (Skinner, 2010). They claim, their exodus from their Ancient Egypt homeland (Agbotadua, 2009, Charles and Mamattah, 1978, Dohnani, 1988) took them through Sudan, through to East Africa and Nigeria to arrive at their present location (Davidson et al., 1965).

Taking further clues from their legendary narratives, they hold it that, they were the first dynasty in Ancient Egypt who developed the *hieroglyph*, the earliest form of writing (Dohnani, 1988). This claim is argued through their traditional artefacts such as the symbols found on their Chiefs' staff of authority, carvings and imprints woven into their traditional textiles depicting characters described as ancient scripts of hieroglyphic writing. This claimed depiction from their ancestry's *hieroglyphic* characters for documentation is however, unintelligible to the present generation who indeed perceive them as mystical embodiment (ibid) for ancestral worship (Gyekye, 2003).

Also, they hold it that the *etymology* of their Ewe language (Dohnani, 1988) vindicates them to the claim of their ancestral homeland i.e. Ancient Egypt. For example, they hold it that the king of Egypt in those days was referred to as Pharaoh, whereas

in the then Ewe language, as it holds today, they refer to their kings as *Fia'o*. This name for kings (Fia'o) is believed to have changed over time (to Pharaoh) when they lost their political power and spiritual influence at the end of their reign. The author in a separate account (Dohnani, 2003) went on to cite several examples to buttress the 'originality' of the Ewe language's linkage to Ancient Egypt and its influence on other languages of the world today.

In fact, they link their ancient roots to as far back as the biblical stories of the Tower of Babel (Charles and Mamattah, 1978) and Moses in contention with Pharaoh (Dohnani, 1988). Their narrative has it that they lost their position (power) when Moses' serpent swallowed those of their priests, (the ancient Egyptian Priests). They finally lost all their powers, first spiritual (magical) and then political when their kings (Pharaoh or [*Fia'o*]) and all the army were drowned in the red sea, as documented in the bible (The-Bible-Exedus-14). That loss to them, meant losing all their intellectuals, army, leaders, etc, the strong base of their society was gone, hence, their vulnerability to date. This includes attacks and invasion, leading to their eventual enslavement by their invaders (the same way they enslaved the Hebrews (ibid)) until their escape through the wall in Egypt and subsequently at *Notsié* (present day Togoland), where they tried one more time regrouping to form another kingdom (Charles and Mamattah, 1978). The festival of *Dogoleglime* (Africa-Works, 2012), celebrated in November by the people of Hohoe District in the Volta Region, when translated means; 'coming out of the wall', is used to buttress the validity of this oral tradition.

According to some Ewe traditionalists, such bitter history makes them very much opposed to any idea of forming a kingdom again, hence their characteristic nature of settling in small groups, also confirmed by the report contained in Africa-Craft (1998). The settlement is done normally under a chief chosen by the people and *destooled* (deposed) by the people. This feature is common to some other African tribes as noted by Davidson (1969), where the space availability in Africa allows for such frequent breakaways from any chiefdom for self-settlement. The issue of availability of space becomes one of the determining factors in shaping the African society and cultures into its current form.

Such secluded settlements in the African cultures render their societies not oriented towards economies of scale for their relatively small sizes. It may therefore be seen as impacting directly on any stimulus for growth and self-initiated development of indigenous technologies or culturally inherited artefacts of production.

2.3.1 Conclusion on Ghana Historical Perspective

In conclusion therefore, what constitutes Ghana today is simply a collection of different ethnic groups coming from different backgrounds to acquire, capture, share, exploit and struggle for space (somewhat like their colonial masters) leading to what today could be called Ghana-land. In terms of its current political boundaries, it is actually the combination of the colonial Gold Coast, the Northern Territories and the merger of the British Trans-Volta Togoland (Lentz, 2006, Skinner, 2010), which defines the sovereignty of its nation-statehood.

The question that comes up however is; how did the Ewe people lose the art of writing, seeing they claim to have initiated the *hieroglyph*, the earliest. Also, their oral tradition, according to their traditionalists, has it that, they brought the loom technology for their traditional textile from their exodus from Egypt. This is claim of originality to the loom is evidenced in a report from Africa Craft (Africa-Craft, 1998) (Africa-Craft, 1998). The loom system, however remains in its traditional state and has never been changed or improved upon. These questions raise much interest in this study as they tend to suggest that the people have rather lost the ability to write, by some inexplicable reason, as opposed to not having had it at all. They are also "stuck", unable to develop their traditional artefacts from their historic form, as can be seen with the case of their historic traditional loom which has never been improved upon.

The explored history of Ghana, therefore suggests that Africans have lost something unknown to this study that should propel them to improve their loom system. They have therefore lost a measure of their technological heritage; this probably, partly explaining the reason for the noted drawback state of the continent.

2.4 Ethnicity and the Ghana Statehood

At this point, it can be established from the ongoing theoretical discussion that Ghana is made up of several tribes (see Figure 1 for map of Ghana showing the ethnic divisions). For example, the work of Fage (1959) showed how Ghana consists of different ethnic groupings arriving at the present settlement in 'a number of waves', with the Guans appearing first and others following.

Each tribal group had its different story of ancestry, origin and migration (ibid); neither do they settle with the same set of rules or system of formation. Depending on the specific conditions and challenges they are faced with, their settlement may develop into a structured society with a clear hierarchical order of kingship/chieftaincy and elders (Englebert, 2002, Odotei and Awedoba, 2006, Skinner, 2010) or they may settle under a formation structured differently from the norm, often described as an *acephalous society* (Lentz 2006). Such societies are generally dispersed over wide regions and only bonded together by common belief system in their cultures, language and dance (ibid). Researchers have shown how such acephalous societies still exist today in different parts Africa and other regions in the world like Papua New Guinea, parts of India, the Amazon Forest and others (Bruce, 2008).

This variance in settlement, as can be seen from the map, highlights the differences that may exist between the various ethnic groups constituting contemporary Ghana. Thus, Ghana is made up of different peoples with different cultures needing to coexist under the bounds of the artificial boundary lines 'given' to them and *accepted* by them. These settling groups, as described by the political historian, David Kimble, lived in a large number of isolated, self-contained societies (Kimble, 1963). These societies are usually isolated by transport difficulties, fear of warfare and slave raiding (ibid). As such, they are forced to run a self-sufficient local economy. To increase their security and survival, they organise themselves on a tightly-knit sense of community and kinship (ibid). The complexity of such seclusion leading to societal segregation probably partly shapes the

absence of a drive factor to seek after improvement to artefacts of use and technology growth.

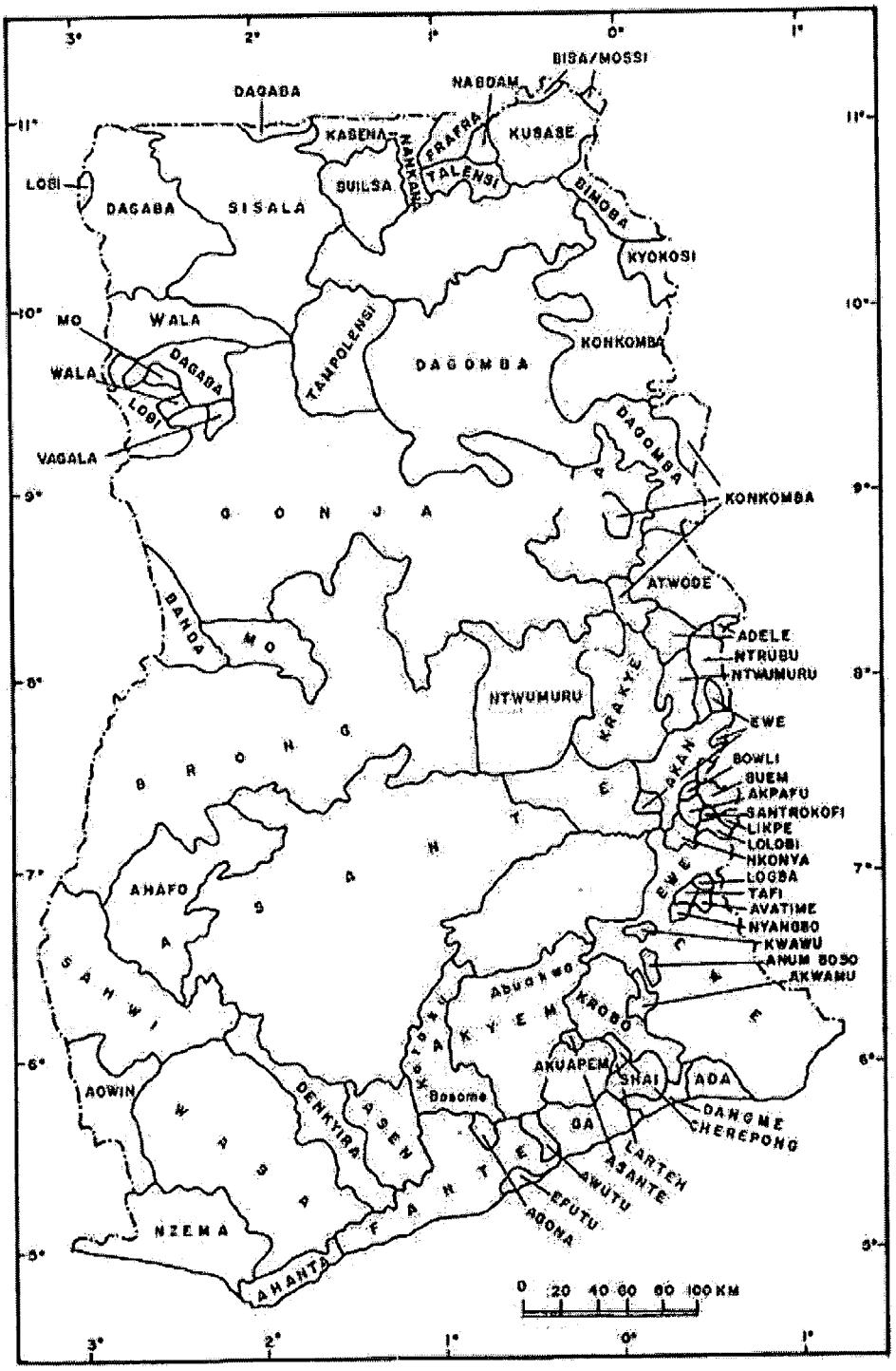

Figure 1: Map of Ghana showing ethnic groups (Odotei and Awedoba 2006)

Looking at Hofstede's model, such 'tightly knit sense of community and kinship' vividly describes collectivism, i.e. a collective society (Hofstede, 1984), a feature of the Ghanaian setting. Indeed the unit of the Ghanaian society is the family (Price, 1975) and not the individual as is the case in a high scoring society of *individualism* (Hofstede, 1984). The interest of the family, clan, tribe (i.e. group interest) overrides personal interests, aspirations or wants.

The benefits of communality may be numerous, but it could be argued here that it holds the tendency to inhibit the maximal exploitation of one's talent, hence, limiting the full potential of a society. More so, communality seems to give occasion to evade individual responsibility and accountability as no one person may have responsibility for something – it belongs to all. Leadership with vision and foresight becomes highly desirable in such society.

2.4.1 The Barrier of Ethnicity Variances to Statehood

As indicated, Ghana consists of several cultures. In the ethnologue languages of the world (Lewis 2009), Ghana is noted to have seventy-nine living languages, excluding their dialects. This, representing ethnic groups, implies seventy-nine different peoples, having different historical and cultural backgrounds and probably at varying stages of societal development, structure and stratification. It suggests a non-coherent and non-homogenous society. The author, Sagasti (1979) noted;

> *...the underdeveloped country does not constitute a homogenous unit from cultural, social, and economic points of view. It is a highly stratified*

> *society with little or no interaction among the various strata and with almost no mobility between them...* (Sagasti, 1979)-(pg. 3).

Griffiths (1986) was able to show how the coming of the Europeans led to drawing the boundaries for African states, which was done without due regard for ethnic boundary areas. Indeed, it is not uncommon today in Ghana to find family lands lying between two countries (Akyeampong, 2001, Lentz, 2006) i.e. separated by a natural boundary line.

Considering the role of the European powers, however, it is suggested by Griffiths (1992) they did not demarcate the boundaries in isolation from the then traditional leadership. But the question that may arise here is; how was the power imbalance from *power distance* (Hofstede, 1984) addressed?; how much say could the traditional leaders have that could have effectively influenced the agenda of their "bosses", i.e. the colonial powers? It is not very likely that the traditional leaders could have had much influence, given that traditional boundaries were never clearly defined at that time as they kept shifting (Lentz, 2006). Indeed, the very fact that present African governments concur to current boundary demarcations raises questions about the system of *sovereign statehood-ship*, which is currently encouraged and enforced (supported [by the UN]) even in failing States (Herbst, 1997).

In considering an alternative to the *sovereign state* system, which was globalised since the Second World War by the United Nations (UN), Griffiths' (1992) suggestion of, agreed administrative controls over cultures overlapping national boundaries may appear plausible, but should be taken with

caution. Though it is claimed to have been successful in the Egypt/Sudan borders, it should however not be concluded that its applicability across the rest of Africa will produce the same results. This is perceived thus; governments differ and the extent of cultural mix forms an important factor in determining a possible outcome as shown by the work of Lloyd (1969).

The work of Herbst (1997), calling for a rethink to an alternative to the sovereign-state currently practiced in greater parts of Africa should be seen in the light of its *acceptance* by African (Ghanaian) political elite, who made no opposition to the drawn boundaries. This is regardless the fact that they were drawn without due consideration as earlier mentioned. As indeed noted, the disruption has not led to armed conflict (ibid), though it gets a *rejection* by some affected parties (Kedem, 2005, Kedem, 2007, Kodzi, 1991), which, however, has not been heeded to.

2.4.2 Inherited Systems of Institutions

It is common to find in African concerned literatures, referring to African institutions as being weak, ineffective and incoherent, and other similar terminologies (Acemoglu and Robinson, 2010; Szogs, et al., 2009; Price, 1975). Price (1975) went on to describe how the African Clarks taking from their colonial Administrative predecessors have it to be problematic. This, he attributes mainly bureaucratic processes, claimed to be unfamiliar to the African cultural setting.

The inherited nationhood of the African States, rather than being earned, as put by Herbst (1997), seems to account for such observation by authors like Price (1997). This, to a very large extend, explains why Ghanaian institutions seem to suffer. For

example, the political institution, as discussed in the following Section 2.5 has been shown to have had lengthy period of turmoil of instability and economic upheavals. Similarly, the inherited educational institution has now been described by authors like, Szogs, et al., 2009 and Johnson, et al., (2003), as being rigid, non-conforming to current changes in the global or business world. Generally, the systems of institutions being inherited are observed, from scholars' viewpoint as cited, to be suffering significantly, mainly by a seemingly attitude of not knowing which way to move it forward as observed by this researcher.

This apparent inherent weaknesses found in the institutions, in the view of this study taking a clue from Price (1997), could be accorded to the fact that they are not culturally connected to the fabric of the Ghanaian society. By this therefore, the new leaders, unfamiliar with the cultural background of these institutions also established in a different cultural environment, are unable to steer the institutions forward progressively. This cultural mix/confusing is here seen as the debilitating factor for their inherent weaknesses and sometimes, eventual failure.

Looking at the work of Hill (1963) and the backbone of the Ghana economy (Nyanteng, 1995), the only Ghanaian institution deemed culturally instituted and running successfully is the Ghana Cocoa Board, commonly called Cocobod for short. Cocobod may its inherent problems, as all institutions would generally have, but it has survived against all odds, being initiated by local resident and migrant farmers, without Government incentives or the International Community finding. Culturally adopting the crop, they advanced its propagation to

even attract Government's attention to realise its economic viability (see Section 7.4 of this thesis). Thus, Cocobod is therefore considered as the most suitable "success project" to fit the requirement of the SIM Approach described in Section 1.6.

2.5 Ghana's Political Struggles and its Impact on the National Economy

Historians like Warner (1960), Davidson (1972), July (1968) and many more praised Ghana's pre- and postcolonial political and economic progress. It can be seen that at the time of their writing, Ghana had just emerged from colonial rule as a young nation. As described by the authors, Ghana was the wealthiest African nation with an impressive political and economic start; it was the leading producer of cocoa and gold, it had good supply of timber reserves and a satisfactory human resource (Warner, 1960). The story however did not remain that beautiful for too long, as Ghana was plunged into a state of extended power struggles, leading to a lengthy period of political upheavals accompanied by economic turmoil and social instability.

A brief narrative of the political and economic history of Ghana is appropriate at this stage: After independence (in 1957) under the rule of the first president, Dr. Kwame Nkrumah, the economy of Ghana was described as impressive, as earlier indicated. It was registering a positive growth of about 4% until the president declared the country as one party Socialist State.

The declaration coincided with an immediate economic decline (see graph of Figure 2 below), as growth rate began to fall from 1964 to 1966 when he was overthrown in a coup d'état by the

police and military forces masterminded by the CIA (Botwe-Asamoah, 2005). This was claimed to prevent Ghana from leaning towards the Eastern socialist economic bloc. A National Liberation Council was formed by the then leaders, Lt. Gen. Joseph Ankrah and Lt. Gen. A. A. Afrifa.

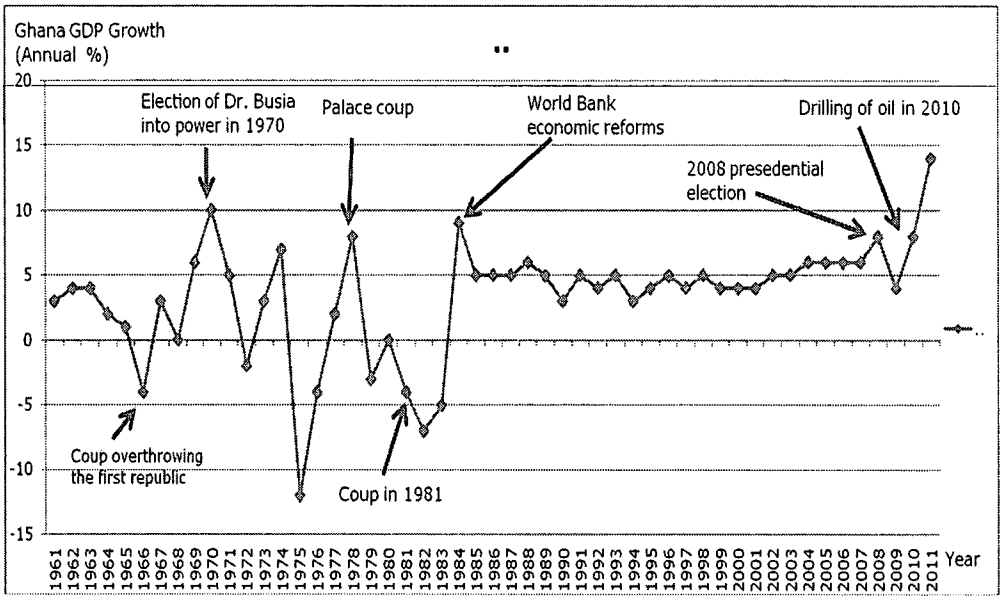

Figure 2: Annual growth rate in Ghana (Data Source: Worldbank, 2012)

After the coup however, the economy began to register positive growth again until the elections in 1969, which saw the return of the country to civilian rule, with Dr. Kofi Abrefa Busia elected as Prime Minister. After the election, from around 1970, came yet another decline. The military being dissatisfied with the performance of the civilian administration staged yet another coup d'état on 13th January 1972 when Lt. Col. Acheampong seized power. This period of military rule saw a brief rise in growth which reached its peak at about 1977. However, the Ghana Bar Association and Ghana Medical Association spearheaded demands for a return to civilian administration. Again, this interference in government affected the economy,

when it began to record yet negative growth rate. Lt. Col. Acheampong was forced to resign in a palace coup in 1978, which brought another military regime into power led by Lt. Gen. F. Akuffo. The negative growth rate however continued and in May, 1979 there was another coup led by Flt. Lt. Jerry John Rawlings who seized power from the military and handed power to civilian that same year. As such, the elections of 1979 saw a comeback to civilian rule when Dr. Hilla Limann came to power in June, 1979. As can be seen from the graph, the economy registered a slight growth rate. The military still not satisfied, ousted the new civilian government in 1981 again by Fl. Lt. Jerry John Rawlings to return the country to another military government, still with the economy in decline.

In 1983, the World Bank supported economic reforms were implemented, thus, reversing the negative growth trend. This regime survived a number of failed coup d'état attempts including one internationally orchestrated in 1986 (Agyeman-Duah, 1987). The resilience of the regime was the start of a stable political atmosphere for the country. The political stability also reflected in a stable economy as can be seen in Figure 1. Subsequent changes in government were no longer through coup d'état and these changes did not lead to serious economic downturn.

In 1990, however, there were calls for a return to democratic rule. The incumbent president, Fl. Lt. J. J. Rawlings, won the election in 1992 to retain power, but this time as a civilian president under the National Democratic Congress (NDC) party. He served two terms of four years each and in the 2000 election, his party lost power to the main opposition New Patriotic Party

(NPP) led by Mr. J. A. Kufuor. He also served two terms after which, in the 2008 election, his party lost power back to the NDC, led by Professor Evans Atta Mills who ruled until his demise in 2012. The then, Vice President, Mr. John Dramani Mahama was sworn in as president to complete the late president's term of office. The presidential election of that same year saw Mr. John Mahama retaining the presidency, and is the incumbent at the time of writing.

The political unrest of the first three decades of independence can be clearly seen reflecting in the economic performance of the country. The economy again, is being seen as impressive (CIA World Factbook 2013 – Economy - overview) boosted by the discovery of oil and gas. The question that comes up here however is how can this new growth rate be sustained, especially as Ghana still imports almost all its technologies. The economic growth could be viewed as superficial since it lacks a domestic technology generating capacity.

2.6 Ghana's Economic Outlook

By and large, the Ghana economy has been heavily dependent on importation of its technologies (Lall and Pitroballi, 2002, Republic-of-Ghana, 2011a), and foreign trade, mainly with the Europeans, long before the era of colonial rule (Fage, 1959). The items of trade had always been direct primary products, first gold, then humans (slaves), after which followed the dilemma of which items of value to trade in when the slave trade was abolished (ibid). At the verge of abandoning the founded territories of Gold Coast by the merchants and the ruling colonial powers for lack of trade item, a trustee to the seat of power

brought to their attention the value of timber, rubber, oil palm, gold, cocoa, cotton, etc., which, restored the interest of the powers (ibid). These items struggled against each other for dominance, until today the main stay of the Ghanaian economy is cocoa, gold and the recent oil find in 2010 (The-World-Factbook, 2013). The cocoa industry, which was initiated by the farmers (Hill, 1963), seems to be culturally assimilated into the societal fabric by the farmers. It has endured all through the Ghanaian history (ibid), thus standing out as a model worth emulating.

As can be seen from Figure 1, such remarkable growth rate in 2011, though highly commendable and desirable, could be misleading as trade is still conducted via the ancient method of primary products with no value addition (The-Republic-of-Ghana, 2011). And a predicament of Ghanaian society is in the main stay of the economy, whereby cocoa consumption (chocolate), gold, the recent petroleum oil find, etc., are all owned by foreign companies. Thus, mimicking a new form of pre-colonial trade system controlled by merchants and the colonial powers, leaving Ghana with little control of the economy (Price, 1975). This suggests that Ghana does not have much control over her economy as these productions require technology and the manufacturing of these technologies, so far, are in the hands of foreign companies for a lack technology base in Ghana.

It has been shown how manufacturing performs so badly among the various sectors of the Ghanaian economy (Kolavalli et al., 2011). Indeed, the high growth rate registered raises concerns whether the local economy will be able to support it with the current rate of indigenous growth, which is a non-technical

growth. This may invariably lead to higher importation to sustain the growth, hence, the fragility of the economy (Aryeetey and Fosu, 2008) remains an issue to address. Increased importation is here believed could intrinsically erode the economic progress achieved in Ghana.

2.6.1 Economic Growth Comparison from Selected Countries/Regions

Using data from the World Bank dataset, Ghana's economic growth as is viewed in relation to randomly selected African countries from 1961 to 2011. The Gross Domestic Product (GDP) of the nation will be used as the means of measurement.

According to the business dictionary (Businessdictionary, 2014), GDP is the value of a country's overall output of goods and services (typically during on fiscal year) at market prices, excluding net income from abroad.

Based on the definition here, therefore, the GDP of the randomly selected African countries, Botswana and Cameroon is compared with that of Ghana plotted on the graph shown in Figure 2 below. When viewed, referring to their colour coding, there seems to be a common feature among the countries of high turbulence in the economic performance from the 1960s with much greater stabilisation from the 1990s. This is very much in resemblance to the case of Ghana where, as discussed in Section 2.5, the first three decades marked high economic fluctuations.

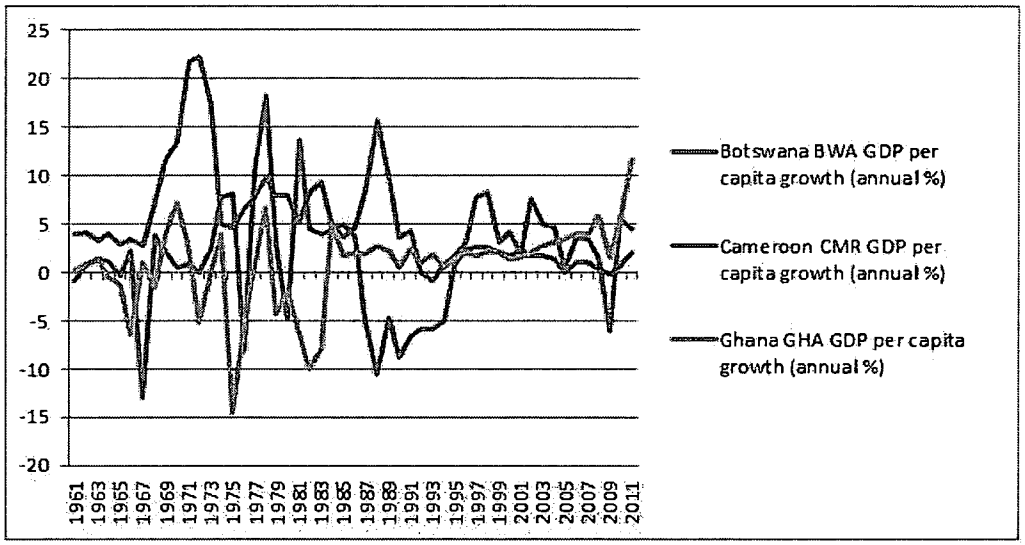

Figure 3: Economic performance of selected countries (Data Source: Worldbank, 2012)

Make similar comparison of economic growth with advanced countries in Europe, like UK and France and other countries like the US and China, it is seen that, though the growth rate are lower, except for China, their GDP per capita, is exceptional high. This indeed, accounts for them being developed countries in comparison to the African developing countries. Table 1 below presents the growth figures of these countries.

From Table 1 below, it can be seen that, in the same year, 2013, while, for example, the GDP for the UK was $37,000, the growth rate was only 1.8%. This, compared to Ghana, which had a much higher growth rate of 7.9%, has a much lower GDP of $3,500. The higher growth rate therefore should not suggest an advanced state. It is simply an indication of growth. Similarly, while the growth rate for France and US may appear lower than the African countries like Ghana, Cameroon or Botswana, they all have much higher purchasing power as in GDP. China seems to be only country, among the those selected, which has high

growth rate, second to Ghana, and high GDP compared to the African countries, except Botswana.

Table 2: Table of economic growth comparison of selected countries in the world for the year 2013

GDP	Botswana	Cameroon	Ghana	UK	France	China	US
Real growth rate	3.9%	4.6%	7.9%	1.8%	0.3%	7.7%	1.6%
Per capita (PPP)	$16,400	$2,400	$3,500	$37,300	$35,700	$9,800	$52,800

This high digits attributed to China, could be as a result of the increase in manufacturing activities in the country, literally, manufacturing for the rest of the world (BBC-News-Business, 2014). Such growth rate may be seen as to be composed of a number of factors probably stemmed from a conscious effort with a business approach.

Comparing China's growth with that of India, for the same fiscal year, 2013, India was seen to register a growth rate of 3.2% and has a GDP of £4,000. China seems to set a mark a head of developing countries. India's performance, though with a higher GDP than Ghana, is comparing to the African countries. It is seen to perform lower than Botswana.

2.7 *Discussion and Analysis of the Ghanaian Society in the Chapter*

This final section of this chapter provides extensive discussion and analysis of the Ghanaian society base on excerpts from the chapter. The analysis makes deductions and inferences from the viewpoint of scholars cited within the chapter. The aim here is an attempt to set a common level of understanding; to try to extract what might be considered as the factors that could, in some way, explain the Ghanaian societal perception or attitude towards its state of technology underdevelopment. It is an attempt to answer the research question from literature.

Thus, this chapter therefore focused mainly on describing the Ghanaian society by looking at the past (history) to understand the present. This is to help determine the direction for the future.

In this study, it was seen that Ghana is made up of several ethnic groups arriving at different times to different parts of the Gulf of Guinea to become what is known today as Ghana. The settling of the groups characterised by displacement, counter displacement, war, migration, slavery, etc., means that, each settling ethnic groups comes with its own language, culture and history.

Among other factors, it is possible, that the whole process of migration, as suggested by some authors, was the result of escaping from enemies with superior weapons (war), famine or other adverse situations (Charles and Mamattah, 1978, Davidson et al., 1965). This coupled with unsettled lives, tribal fear and a struggle for survival (Kimble, 1963) could have led to their discarding any relics of heritage such as writing skills. Thus, they

were unable to explore beyond their environment as compared to their Arab or European counterparts who came from afar to find them and trade with them in gold and slavery. How Africa was left out of the world development loop remains a mystery, as it is the only continent without a record of invention (Davidson et al., 1965, Edgerton, 2008) and the art of writing (Austin and Headrick, 1983, Davidson et al., 1965).

As the Chapter points out, the failure of African society in retaining their writing skill could be due to the new hostile environment they found themselves in. The environment (i.e. new surrounding) needed to be conquered on every side – from challenges in nature to invasion by neighbouring tribesmen, Arabs, Europeans, slave raiders, etc. Besides, their traditions did not seem to stimulate them to finding alternative and better ways of doing things they already knew how to do; they stayed put with the inventions of their ancestors (Haverkort et al., 2002). In not improving on ancient artefacts (methods) of production, the result is keeping a low productivity level. It is noted that 'traditional societies at a low level of economic development tend to be fatalistic' (Hofstede, 1984), hence, their weakness, assuming a state of helplessness. This, culminating eventually with the occupation by the Europeans of Africa, who indeed served as security for the smaller tribes against the bullying domineering ones, such as the Asante Empire (Arhin, 1990). This *accepted* occupation ultimately led to the creation of the sovereign nation-states throughout Africa. According to Herbst (1997), such a nation-state was not earned, but inherited as they were created by the Europeans in 1885 and handed over to the natives upon attainment of independence (ibid). By this therefore, the new leaders having no experience of running a

nation-state made a lot of errors. The International Community, especially through the UN had to continuously support and defend the sovereignty of these states even when they were technically failing states (ibid).

The author (ibid) went on to point out how the new African leadership worked towards 'flattening' of the ethnic landscape. In effect, they had an agenda of creating a *mono-cultural state* out of the inherited sovereign state of different ethnic groups of diverse cultures.

In the case of Ghana, the new state pressed further its desire for expansion, thus annexing the neighbouring British Trans-Volta Togoland. This was done through a plebiscite in May 1956 to form a union with Ghana (Kedem, 2005). There was however a *rejection* from within the Trans-Volta Togoland (Skinner, 2010). This *rejection* into the 'interference of the status quo of inter/intra cultural/ethnic' boundaries was suppressed by high-level powered political operatives from both national incumbent government and supporting international colonial allies (ibid). Skinner (2010), drawing on the work of Kodzi (1991) and Kedem (2005 and 2007) further highlighted the struggles of such differing political opinion to the then autocratic single-state government of the first republic of Ghana. The government then took no cognisance of local boundaries, like their colonial administrators. Indeed, the 'new' leaders of the post-colonial government in West Africa, did not take much cognisance of Africa's history, perceiving it as irrelevant for the new government (Herbst, 1997).

Herbst went on to explain how the new African leaders had kin interest to keep the nation-state, as created by the colonial

powers if they cannot expand on it. According to Davidson, et al, (1965), West African tribes are not united, they are all different and prefer to stick to their differences, keeping to segregated societies of almost self-sufficiency. This explains the prevalence of many cultures, leading to the attempt to 'flatten the ethnic landscape' (Herbst, 1997), thus, tantamount to calling for a *monocultural* society.

The concept of *monocultural state* (monoculturalism) was probably seen as a vital tool for developing *a technology base* for their newly acquired states. As with the case of Ghana, it would have to overcome all the language barriers hampering effective communication. Currently, the method to overcoming such barrier is through the formal education system where people (students) from cross-cultures mix up together in schools, boarding houses and universities. As they graduate, they take on employment, again, in a mixed cultural environment mainly in the cities, but all working towards the objective of their employment, thus, forming the elite group of the society. This group is mostly cut off from the traditional sector, which is concentrated in the rural areas. Most of rural Africa is however, marginalised by central governments (Herbst, 1997).

As this chapter points out, the whole confusion of statehood is clearly reflected in the extremely unstable political climate in Ghana in the first three decades after independence. The politically unstable climate negatively impacted directly on the national economy. However, from 1983 the economy began to stabilise as the political controls stabilised as well. The stabilised economic growth does not however, translate into indigenous control of the economy; the businesses handling the resources

on which the economy thrives are all foreign owned (Government-of-Ghana, 2013), hence, Ghana cannot be said to have control over its national economy. This is mainly because it lacks the necessary technological prowess to extract and process its natural resources into finished products. Therefore, this study posits that if Ghana is keen on controlling its economy, it necessarily needs to find a way to be responsible for manufacturing some of its needed technologies, especially those for production of goods or services. The role of the educational system is indispensable in this regard.

No specific study was found by this research, focused on the impact of education on manufacturing in Ghana. Such a study may probably not exist as the issue of manufacturing in Ghana, has hardly received any considerable attention as has been noted by this study.

CHAPTER THREE

3.0 INSTITUTIONALISED TECHNOLOGY DEVELOPMENT FRAMEWORK PACKAGE FOR AFRICA

3.1 INTRODUCTION

This chapter continues on the effort to seek a better understanding from literature with respect to the African technology issue. Here, however, the focus is an attempt to establish a level of grounding in institutional arrangements and structures and the role of institutions, as to how they constitute a framework on which to build an economy. In this study, the use of technology is viewed as the leading factor on which to build a firm national economy. Some economist and economic theories conform to a similar position, which have led to remarkable efforts and outcomes in frameworks and models for the developing world like Africa, common among this is the *appropriate technology* movement (to be discussed later in this chapter).

In fact, observers of the African economic outlook have focused much effort to help address the seemingly persistent economic turmoil of the continent. Some of such contributions have been distilled into various forms of institutionalised models of technology development deemed suitable for Africa. These benign intentions form the basis of discussion here. Taking into account the theoretical analysis so far, Africa seems to lack the impetus to develop its technology to carry out the prior-needed task of harnessing and processing its endowed natural resources

into finished goods to benefit itself and the rest of the world. This prior-needed task is how to generate its needed technologies for production. At the moment, observation and the work of scholars have shown it is lacking and the numerous global and national efforts at addressing the problem still leaves much to be desired. This chapter therefore sets out to explore worldviews on technology creation for developing countries by examining development approaches from economic theories/principles, planning and concepts that could provide better understanding to building a framework for Ghana's technology creation.

3.1.1 Localising the Institutionalisation Concept

Economists have observed that for centuries the global economy has been going through different transitions with each leading to new understanding and therefore postulation of a corresponding new theory. This has been the trend as far back as to the days of Adam Smith to Kuznetzian growth pattern (Schumpeterian growth) based on innovation (Goldstone, 2002). Current trend of global development shows that majority of advancing developing countries like Korea, Malaysia, China and the others have benefitted very significantly from this growth pattern. This has lifted their economies out of abject poverty into wealth, projecting them as global leaders in technological innovations. Africa, on the other hand, has remained "immune"', responding extremely slowly to this wave of technical growth registering around the world, thus lagging behind other regions (Lall and Pitroballi, 2002). The lag has led to persistent global concerns as to how to relieve the continent of its poverty tags. This is reflected in the large number of postulated approaches and models of development. These models are however built on

institutions whose arrangements and structures are defined within the constraints and cultural perception of the participant industrialised country. In that industrialised country, its institutions may work efficiently, but when transposed to a different geographical setting with distinct cultural variance, its features may no longer function in the same vigour leading to institutional failures in Africa.

Take for example, African nations, with Ghana in focus, in their efforts to develop technologically; they adopt (or are imposed with) these institutional frameworks devoid of cultural and traditional considerations. With such obvious absence of an indigenous grip and local content, they are surprisingly still expected to work with the same vigour and efficiency (Price, 1975). Such expectation is, more often than not, misplaced. Indeed, it has been shown how institutions in Africa are weak, fragmented (Johnson et al., 2003, Lall and Kraemer-Mbula, 2005, Lall and Pitroballi, 2002, Lall and Pitroballi, 2005, Szogs et al., 2009) and in some cases, some specific institutions, like hospital or school in the village, do not actually exist. This chapter therefore argues that due consideration of location is a sine qua non for the incorporation of institutions in the traditional sector into the agenda of technology creation and development for an accelerated technological growth, and hence, economic growth to be achieved.

3.2 Technology Proposed for the Developing World

This section sets out to theoretically investigate the worldview on technology for developing countries. In considering this topic, the most popular approach to technology concerns, for developing economies is the concept of *Appropriate Technology* (AT).

AT has come a long way, attracting several admirers and detractors alike. Weighing their views against each other, the critics have questioned the axiom of its claim to being a means of technology provision for developing countries. In similar manner, its advocates hold firm claim to its practicality in meeting the technological needs of the downtrodden poor in the non-modern sectors of developing countries. This signifies a bottom-up development approach.

It would however be argued here that any technology developed [in Ghana] would have to be appropriate. That is, it should be appropriate in the sense that, it should perform efficiently and not just be assessed on the basis of the of AT, which is; low tech, labour-intensive, indigenous, low cost, etc. Indeed, some proponents to the movement actually claim such notion of focusing on low tech to be a misrepresentation of the true idea of the concept (Jaquier, 1976). AT will therefore be studied to assess its stand.

In summary, therefore, this Chapter critiques the general view of AT as put forward by its proponents and countered by its critics. Also, it examines its applicability and practicality to the Ghanaian

scenario. It is therefore essential at this stage to comprehend exactly what AT is in the context of this thesis.

3.2.1 What is Appropriate Technology (AT) and How did it Come About?

The term, *Appropriate Technology* (AT) is almost synonymous with the renowned economist, Dr. Ernst Fritz Schumacher. Dr. Schumacher was known as an economist, journalist and an entrepreneur. He worked for the British National Coal Board (NCB) as an Economic Advisor for twenty years. He also served under the auspices of the United Nations to Burma as an economic advisor after distinguishing himself by working for the British Treasury (Akubue, 2000). AT has a long beginning that can be traced to his work concerning the less economically privileged economies.

Initially unimpressed by the treatment large organisations like NCB subjected their workers to, coupled with his experience in Burma (i.e. witnessing the low per capita income of the Burmese and the inadequacies of the conventional growth-based development strategy based on capital-intensive technology from the industrialised countries), Schumacher, according to Akubue (2000), was propelled to seeking an alternative approach to economic growth for poor countries, which will be human centred. Schumacher was concerned 'exclusively with the problem of helping the people in the non-modern sector' of developing countries (Schumacher, 1974), in other words, the very poor and marginalised rural population of the developing world, whose lives are characterised not only by dire poverty but also by hopelessness (ibid).

Thus, such deep concern of Schumacher led to the creation of the *Intermediate Technology* (IT) concept (Akubue, 2000, Jaquier, 1976, Schumacher, 1974). The IT concept eventually led to the Intermediate Technology Development Group (ITDG) focusing on providing affordable intermediate technologies for poor countries, i.e. technologies lying somewhere in-between the highly sophisticated capital-intensive technologies of the industrialised world and those of primitive production methods found in rural sectors of developing countries.

This IT concept is geared towards having a production technology system not as expensive or sophisticated as those used in the high-tech industries. It sought a form of technology that would be relatively easy to produce (manufacture) and maintain, relying a lot more on the use of local and renewable materials and local skills. That is to say, it should be an affordable technology for the poor.

The fundamental feature of his idea was aimed at mass job creation and not necessarily at the technology. As in the words of Mohandas Gandhi, instead of mass production, 'production by the masses' (Akubue, 2000).

This form of technology is not expected to be highly efficient like those used in the industrialised world, but to serve as a stepping stone to climb up technological heights. Also, its starting inefficiency is expected to be compensated for by requiring more hands, thus leading to the desired mass job creation, rather than the high efficiency mass production technologies, which require fewer workers (Schumacher, 1974).

This *Intermediate Technology* idea of Schumacher eventually became what is now known today as *Appropriate Technology* (AT), as shown by Akubue (2000).

Taking on a historical perspective, it has been shown that the principles and practice of AT were actually in use in India and China long before its popularisation through the concept of IT to its current form of the AT movement (Akubue, 2000, Jaquier, 1975). The patriarchs of the ideology describe it variedly under such pseudonyms as 'production by the masses' (in India) and 'walking on two legs' (for China).

These progenitors, the then leaderships of India, Mohandas Gandhi and China, Mao-Tse-tung, should be credited for their determination to tackle rural poverty by coming up with their self-initiated development strategies. The concept of *self-initiative* as enunciated by these leaders makes it very important for this discussion.

Various authors present the idea of the AT movement from different perspectives as either critics or adherents, albeit both groups appear to converge on a similar line of thought, i.e. the potential benefits AT could confer on developing economies. The position of some critics on the one hand is that, AT is inferior and stands as a distraction to the developing world pursuing their own development paths to optimise their potentials (Kaplinsky 1990 and Willoughby 1990). The advocates, on the other hand, see it as the ideal springboard for poor economies, whereby, they would start from a low base and develop higher up into the forms of technologies most suited to them – culturally, geographically, socially and otherwise (Akubue, 2000, Jaquier, 1976, La Frenierre and Szyliowicz, 2008, Schumacher, 1974).

The concept, as we have it, has evolved with several definitions emerging from various scholars. Indeed, it assumes different forms of descriptions and nuances, such as; low-cost technology, alternative technology, labour-intensive, indigenous production, intermediate technology, etc. These are generally viewed as similar terminologies and often interchangeable in usage, but they carry their various differences as to their specific application (Jaquier, 1976). It is however sometimes difficult to pinpoint a clearcut difference between them as they overlap in their objective of application in a developing economy (Teitel, 1978).

As demonstrated so far, several definitions have been put forward by various authors (critics and adherents) of the movement giving it different perspectives of opinion. The concept therefore seems to gain a never-ending quest for thorough investigation into the extent of its applicability and anticipated outcome. For example, some see it as an approach for community development (Akubue, 2000, Dunn, 1978), with the implication that it fits well into the structure of the community, while some also describe it as transitional technology, i.e. working towards more powerful and efficient systems of production (Betz et al., 1984, Hazeltine and Bull, 1999). Some scholars however, delineate it on the basis of its forming principles, as technologies best suited for mass employment within communities of the developing world (Thornman 1979). The list may go on and on.

All the given descriptions, however different they may appear, relay a similar understanding of its originality of being the technology designed for non-industrialised economies where the acquisition and use of capital-intensive technology is deemed

problematic and unsustainable, or rather, inappropriate. In other words, they are technologies meant to help poor countries improve on their economies, as such; they are deemed as technologies of low grade, because in every respect, they should be affordable and easy to maintain.

Though originally developed for the developing world, AT now finds application in the industrialised countries in the field of environmental protection (Jaquier, 1976) since the advent of the concept of *sustainability* (O'Brien, 1992, United-Nations, 1992a). Here, the industrialised countries are now cautious of the technologies they employ in their productions to minimise its negative impact on ecology, human culture, economy and society at large. (The subject of *sustainability* will be later discussed in this study, as such; further details will not be provided here.) Hence, AT is no longer limited to developing countries only, however, for the purpose of this discussion it will be viewed solely as a package designed for the developing world.

In examining AT as a concept for the developing world therefore, this Chapter has observed that both proponents and critics agree that the technology, more often than not, is generated from the developed world. Looking at the concept so far, with the exception of India and China as progenitors, its tenet of problem identification through to its working out of a solution occur without the beneficiary's (the concerned developing economy) participation. That is to say, from problem definition to concept design of the required technological artefact, through to its manufacture and eventual installation and final disposal are all done by the developers in/from the industrialised countries, thus outside the domain of the developing world where it is intended

for usage. This feature of AT raises questions on the recipients' ability or inability (Sen, 1999) and calls for serious thought in achieving its aim (whereby the recipient economy will be able to work its way up the technology ladder). It is not clear how such aim could be achieved when the conception of the solution to their problem is not part of the recipient's initiative or involvement in the process.

This presupposes that, arguing on grounds of cultural values, the problem identified by the developers is probably not a problem to the beneficiary community whose cultural interpretations may place 'value' differently from the developers' perspective. For example, wealth creation may not be the value of all societies, as such; what a developer may see as 'poverty' may evoke a different interpretation in a different cultural mindset. This however, does not displace the basics of human needs common to all mankind; it is how it is perceived that is the issue here. But the point where cultures meet is indisputable in that, it is common to all humanity.

If so then, it naturally follows that there may be no incentive for the beneficiaries to follow-on on the technology to maintain and improve on it. This probably explains why several development projects dwindle and fail soon after the departure of the expatriates (La Frenierre and Szyliowicz, 2008).

The long term survival of AT therefore becomes doubtful, as governments of the developing countries occupy themselves with trying to catch up with the developed world (Chevalier et al., 1992) and still remain predominantly dependent on advanced technological solutions. The developing countries seem deficient in outlining a self-initiated framework to identify their

technological needs and provide them with the appropriate technology. This however is not always the case at all times in some countries. Some developing countries at certain times in their history have demonstrated, out of their own initiatives, appropriate technological solutions to address their peculiar challenges in similar manner as in India and China - only, these were short lived.

One example of such developing society is the case of the Ibo People in Nigeria who, during the Biafra war (Nigerian civil war) manufactured their own food processing machines and ammunitions for the battle (Jaquier, 1976). Likewise in Ghana, to curtail the suffering of the civil servants and the population in general during periods of hardship characterised by restricted manufactured imports, the "technical men" and craftsmen took on the task of producing (manufacturing) various artefacts of daily use for the population. This was even to the point of producing vehicle spare parts, body shells and assemblage with engines supplied from Europe (Edgerton, 2008, Jaquier, 1976). All these feats, however, have disappeared quietly into history. The question then is, when the periods of difficulty elapsed, what happened to these production drives and initiatives? There seems to be no more motivation to develop their home technological endeavours any further. This therefore suggests that the problem of technology in Africa is not the inability to engage in its manufacture, but the problem goes beyond the creation of the physical technical artefact, as such; the values and aspirations of the recipients, their cultures, customs, perceptions and the society in general call for rethinking in line with their institutional arrangements and structures. This is with particular interest to the *role of the traditional institutions*.

Time and space will not allow this study to adequately expand on this theme of traditional institutions. It will therefore be reserved for further detailed investigation in a future separate study. However, it will be helpful in this discussion to establish some amount of understanding on the emergence of the concept of institutions as an economic development framework. The economic development approach on this occasion focuses solely on the use of technology. As alluded to earlier, when talking about technology in the developing world, AT continues to strike a chord as the dominant platform to provide local technology for the deprived society, though the technologies do not have a localised blueprint.

3.2.2 Appropriate Technology (AT) in the Balance

Authors like Edgerton (2008) have noted how, though AT assumes a position to address the technological needs of the developing world, in terms of its appropriateness of localised low cost technology, no country has been able to grow its national economy based on such 'appropriateness' in technology. This sub-subsection will attempt to analyse this view through both the critics and proponents of *appropriate technology* (AT) and *manufacturing technology* (MT) for their ideal relevance to profitability, in contribution to the national economy.

Differentiating between AT and MT, has the most significant contrast being, AT is generally low tech, as shown by authors like Jaquier (1975) and others. MT on the other hand assumes a higher level of sophistication, as it is the technology designed for manufacturing other technologies or products. This however should be confused with high-tech, as a manufacturing

technology could compose of simple basi tools like hammer and chisel. Section 4.2 of this thesis provides more discussion on the topic of MT and differentiating it from manufacturing of technology (MoT).

In a direct comparison, there may be no right answer as to whether AT or MT offered a better solution to a society as this may be dependent on how both are defined or what constitutes the societal need. They all have to be 'weighed in the balance' of the economics and other social and cultural factors.

The technology transfer to developing countries over the decades has been found to be flawed as articulated by authors such as Jaquier (1975) and Akubue (2000). As presented in this discussion thus far, developing economies need to reconsider such conventional approach of capital-intensive technology acquisition vis-à-vis a more cost-effective and sustainable one. The long term benefit of the investment in technological pursuit should be a priority in decision-making. This is because; technology has its politics and power (Winner, 1980) to influence society besides wealth creation. Indeed, wealth is power. In fact, the capital and technology intensive approach to development is found to be in the interest of powerful groups, mainly those classes of people who own and control global corporations as well as their client classes in underdeveloped countries (Brown, 1977). It has been shown that these classes of people have their interests backed up by force (ibid).

It has been highlighted by scholars how application of such capital-intensive technologies does not actually directly benefit the majority of the population in the developing world (Brown, 1977, Edgerton, 2008), hence, their unsuitability for poor

economies, as may be argued. This unsuitability led to the development of AT, which has been the subject matter of discussion so far.

AT, without question, has proved to be very useful to several communities in the developing world as argued by its proponents. The proponents further emphasise that AT is not meant to remain "poor", low-grade, etc., but is expected to be built upon (improved) by the indigenous people when the developers leave. As can be seen from the work of Jaquier (1976);

> *...appropriate technology should first and foremost be an indigenous creation of the developing countries themselves and the central problem they have to face is that of building up an indigenous innovative capability and not that of importing more foreign technology* (Jaquier, 1976)-(pg. 25).

Indeed, this is the crux of the matter; if the indigenous people could build their indigenous innovative capability for AT or raise their technological threshold to the level required to match up with Western material culture, then the problem would have been solved and there would have been no need for undertaking this study. The question therefore is; how can they build their indigenous innovative capability when nothing of such has ever been seen to occur to any significant level among most of the tribal or indigenous people? Even in cases where such capability build-up was demonstrated by indigenous people (as in the earlier examples of the Ibos of Nigeria and craftsmen in Ghana), it soon died out. In simple terms, they themselves have not been able to demonstrate the ability to sustain the practice. The

required stimuli (or institutions) that can stir up such drives need to be identified or defined first.

It has been shown how India and China, the original 'inventors' of AT were able to demonstrate their *indigenous innovative capability* in building their economies, so much so that their national economies have been growing at remarkable rates. Take for example, the concluding remarks of Bosworth and Collins (2007):

> *...In international comparisons, China's achievements have truly been extraordinary, but India has also grown at a rate that matches the other industrializing economies of East Asia...* (Bosworth and Collins 2007)-(Pg. 21).

This position of the AT movement, that the basic technology handed to the developing community, should be further developed upon by the indigenous society, is extremely difficult to foresee happening; difficult to foresee in the sense that the indigenous communities have not been able to demonstrate such capability to focus their attention to improving their artefacts of technological heritage. This is not to say they are incapable of improving their systems, but the argument here is, they have not, as far as history can tell, been able to demonstrate such capability. It is this "incapability" that has created the void which now requires a circumspect solution. The AT promoters, attempting to fill this void with their "benevolent" projects of providing technological solutions seem to rather make the void more pronounced by requesting a performance (of self-initiative to improve a given technology) which has not been found to have happened.

As can be seen, while the indigenous initiative is lacking, the work of AT promoters and Development Agents therefore may never go beyond the current traditional activity of providing the communities with their needed technologies (AT) continuously, thus setting in place a tradition of cyclic AT supply. To a very large extent, as earlier noted in the previous chapter, cultural differences between the AT providers (the benefactors) and the recipients (beneficiaries) may account for an inherent 'weakness' in the whole approach of the AT Movement in, say, Ghana. The recurring question hanging over the drive is; what is the *traditional system* and its various institutions doing to create the technologies needed for their local economies? Is there significant awareness of their capability to create, develop and improve their own technologies? This may require further studies elsewhere. It may be helpful for this discussion to look at how creating institutions could help fill the void.

3.3 The Role of Institutions in Technology Creation for Socioeconomic Development

As pointed out earlier, a detailed study is required to investigate how the traditional setup, [in Ghana] (which, in itself presents a complex relationship comprising of varying cultures from different ethnic historical backgrounds), with its institutional arrangements and structures (Lin and Nugent, 1995), could contribute to the building up of a manufacturing technology base for the nation. The traditional sector, which is relatively less covered by researchers, could possibly rather provide greater understanding to the quest for economic development, since it is mostly native to a people.

Unfortunately, however, the traditional sector, to a very large extent, has not received the needed attention from national governments, who have persistently modelled their system of governance to reflect the structure of the developed world (Chevalier et al., 1992, Edgerton, 2008), hence, adopting their mode of institutional approach. Indeed, they sought to flatten the traditional landscape, as previously highlighted. Developing countries like Ghana, seems to have directly adopted the foreign system of institutional arrangements and its overall structure as suggested by Herbst (1997) and Price (1975). As stated earlier, this has led to a persistently bureaucratic system of inefficient, weak or inexistent institutional linkages (Johnson et al., 2003, Lin and Nugent, 1995, Price, 1975, Szogs et al., 2009). How these institutions can be structured in the context of the traditional sector to enhance its linkages for technology creation and development by itself is the challenge in this subsection as the traditional sector is noted for not consciously able to make improvements to its artefacts and processes.

3.3.1 Formal and Informal Sector Institutionalisation

Ghana, emerging from its traditional (informal system) ways of doing things, which is non-formal, non-universal and comparatively, less efficient, is confronted with the more structured but bureaucratic formal system (Davidson, 1992) to work with. The two systems seem to be in contention, as they are unable to merge even when they have duplicating roles (Englebert, 2002). This sub-subsection of the thesis intends to establish a common ground understanding as to what institutions are, looking at the significance and disputation of the traditional (informal sector) and formal sector institutions.

The realisation of the relevance of institution in economic development is actually a recent occurrence and has led to a new branch of economics referred to as *New Institutional Economics* (NIE) (Chang, 2003, Lin and Nugent, 1995). According to Lin and Nugent (1995), although NIE is essentially microeconomic in perspective, it also includes several distinctive approaches to the analysis on institutions, each with its own techniques, concepts, advantages and disadvantages.

The economic theories of NIE do not in themselves have any direct bearing on issues of technology or its creation, but, giving a broad understanding of the term and description of institution, its arrangements could be seen to, not only greatly influence, but also determine the position of technological growth and creation. For example, standard economic theories could not predict the economic transformation and growth in Korea, because it did not anticipate the effect institutions had on the working environment, conditions and attitude of the people (Chang and Evans, 2000). Like all other industrialised (or, industrialising) nations, Korea's economic transformation is attributed to its technological achievements, hence, its rapid technical growth (Lundvall and Borras, 2005). Institutions, is therefore seen to play an indispensable role in economic development, which, invariably is technology dependent. This work, not being a study of economics may not delve into its extensive discussion, but would seek to underpin the relevance of the concept of institution on to technology creation and development, i.e., culturally sensitive institutions in "natural linkage" with existing cultural institutions. In doing so therefore, it would be helpful to lay out clearly, for common ground

discussion, what is meant by institutions using the work of Lin and Nugent (1995).

According to the authors, the term institution is used in a variety of ways, and may be defined as a set of humanly devised behavioural rules that govern and shape the interactions of human beings, in part by helping them to form expectations of what other people will do. The authors pointed out from the definition why institutions could consist of both formal entities like laws, constitutions, written contracts, market exchanges and organizational by-laws and informal counterparts like shared values, norms, customs, ethics, and ideology. In short, all such institutions involve rules that can constrain behaviour over a certain domain and give rise to behavioural regularities. This study therefore wishes to place emphasis here that institutions are people oriented. In other words, they are created by humans and for humans. They cannot function on their own, but need people's commitment for efficient functioning.

By this therefore, it can be seen and said that human behaviour, when viewed under the scope of perception, attitude, etc., culture, is fundamental to their operation. This could be traditional (customary) institutional culture or formal institutional culture.

As mentioned earlier, members of an institution are governed by its rules (depending on the functions of such rules), which impact on their behaviours and attitudes and they in turn bring about institutional change as they likewise impact on the institutions, thus, creating a two-way system (Chang, 2003). This two-way system actually explains why and how institutions are formed with new ones emerging, sometimes to compete (Chang and

Evans, 2000) for dominance. The emergence of institutional competition signifies the variances in human behaviours.

However, when talking about formalising traditional institutional systems, some pertinent questions come to mind. For example, in the Ghanaian traditional sector or system, what constitutes its version of an educational setup as an institution? How does one formalise the educational system of the traditional institution (when there is none, if there is none)?

For a common ground discussion; if education is considered, for example, as a structured system for the acquisition of knowledge, then could oral tradition, from the traditional sector (Gyekye, 2003), be thus defined and formally institutionalised? This contention comes up since Africa's system of knowledge, as in oral tradition and training are neither structured nor synchronised with the formal educational structure, hence giving rise to dispersed institutions. Indeed, oral tradition (informal) is not recognised in the mainstream educational system in Ghana (World-Data-on-Education, 2010/11). Similarly, the chieftaincy institution has remained isolated from the formal sector and relegated to customary interpretations (Beall and Ngonyama, 2009, Davidson, 1969, Englebert, 2002). These signify the non-existent institutional linkage between the formal and the informal (traditional) sectors. This institutional scenario applies to other settings of both the traditional and formal sectors as their institutions often do not interact, thus, posing significant challenge to overall development agenda. Such conspicuous problems make the study of the formation and development of the traditional institutions relevant in the use, creation and development of technology in the society, taking cognisance of

the significance of the traditional sector as constituting a component of originality in the Ghanaian demography and societal setting.

3.3.2 Economic Theory for Technology Development in an African Setting

The prompting to this discussion on incorporating the traditional sector institutional framework stems from an observation of the history of economic development theories (Chang, 2003, Johnson et al., 2003).Evolution of the theories originating from Adam Smith's laissez-fair have progressed to date where the role of institutions and institutional learning (Freeman, 1995, Johnson et al., 2003, Lundvall, 1992/2010) has taken an expanding ground. The changes in theories to answer emerging questions were driven by variances in economic determinants, which a foretime were considered exogenous (Johnson et al., 2003, Szogs et al., 2009), hence, irrelevant to economic analyses. These economic determinants are driven by technology and innovations in technological applications.

The trend in developing new economic theories is based on the failure of an existing theorem to address a prevailing or new economic phenomenon (Goldstone, 2002, Johnson et al., 2003), thus, leading to emerging theories or concepts (Chang, 2003).

However, these economic analyses and theorems were postulated from the perspective of the developed world, though using data from the developing world as indicated by Johnson, et al., (2003). Developing countries only adopt these models (from free market (free trade) to protectionism (of infant industry), to interventionism, import substitution, etc.), only to realise they

fail in providing that transformative edge needed in their economies (just as they have been used and abandoned for better explanations and theories in the developed world). Even the so-called new world order, which was highly esteemed, is now found to be misleading and disappointing failing to address poverty problems of developing nations (Chang, 2003, Sachs, 1992, Sagasti, 1979).

The new world order, a move towards global citizenship, seems to be backed more the capital business world of franchise and technology propagation from a monopolistic stand (Brecher et al., 1993). This approach points to a long term further marginalisation of developing countries from the threshold of development, especially in technology.

Developing countries like Ghana seem to carry on with the tradition of *"accepting"* whatever *reforms* to economic theories and models which have been developed for use at the international level, thus, moving in the shadow of the developed world (Haverkort et al., 2002). That is to say, developing-country-enhancing economic theories, models or strategies have not yet been found and will need to be developed.

This study, not being an economics thesis will leave it for a different study elsewhere; however, it may be worth mentioning here that a new economic approach for Africa is required. The new economic development [theorem] approach invariably should consider the unique peculiarities and constraints of the African scenario. Some of these peculiarities and constraints include taking into consideration Africa's traditional and other social phenomena (as previously shown). In this case, there would be a review of the methods of trade and transaction. This

could include modern system of cash or card and the re-introduction of the barter system to cut down cost of producing and maintaining the cash and its circulation. A [new] matching accounting method may therefore be required here to adequately capture trade transactions including the barter system.

3.3.3 Institutions and Modern Economic Concept for Technology

Modern economic theorems highlight institutions as major actors in innovation and development approaches as can be seen in the still evolving concept of *National Innovation System* (NIS). As a system originally designed for the industrialised societies to understand the role of technology and innovation in economics through a learning process between firms (Freeman, 1987, Freeman, 1995, Lundvall, 1992/2010, Lundvall, 2007, Lundvall and Borras, 2005), it is claimed by scholars to be applicable to the developing world (Johnson et al., 2003, Muchie et al., 2003). Proponents of NIS, indeed claim, its data used in developing the concept were obtained from the developing world (Johnson et al., 2003) hence; its suitability for adoption and application in African countries. This probably led to the inception of the concept National Technology System (NTS) with developing economies in focus (Lall and Pitroballi, 2005).

Whilst NIS sees knowledge as the most important resource and learning the most important process (Lundvall, 1992/2010), and focuses 'mainly on the creation of technologies in advanced industrialised economies' NTS places 'greater stress on the incentive regime (like trade, and competition policies, which

differ more in developed countries) and market and institutional failures in learning (again, more pervasive and stringent than in developed countries)' (ibid).

NTS is however not aimed at technology creation, as deduced from authors (Lall and Pitroballi, 2005), but recommends technology acquisition and adaptation by the developing economies.

A recommendation as this is seriously contested here on the grounds that it has been conventionally used as a method of *technology transfer* for the developing world; a well-tested approach which has consistently failed to yield any lasting solution to Africa's problem of technology lag (Chevalier et al., 1992, Portes, 1976, Sagasti, 1992). This therefore suggests that NTS, as a system, lacks the confidence in establishing a mode for technology creation in a developing country, hence, projecting a potentially bleak technological future for the continent. Avoidance of working towards a futuristic technological planning for a society like Ghana with low level of technology invariably suggests a systemic ideology projecting the inherent institutional weaknesses that often depicts African countries with a "glass ceiling" to its technology development. Arguably, it might be difficult to find the niche (Geels, 2004) in developing countries to building their own system of technology creation, improvement, and development (from either their formal or traditional setting), hence the persistent failures in instituting an industrial economy in Ghana (Government-of-Ghana, 2013, Lall and Pitroballi, 2002, The-Republic-of-Ghana, 2011) or African in general. The difficulty in finding a niche could be argued to emanate from the absence of a technological base, created by African's perception and

approach to problem solving different from others (Haverkort et al., 2002). For example, according to records, the world has not received any form of invention from Africa (Edgerton, 2008). In other words, no invention ever came from Africa.

Such notion may weaken one's confidence in the capability of the African society as seen in the NTS. Though the world may hold no records of global inventions coming from African as shown by technology historians like Edgerton (2008) and Austin and Headrick (1983) and Africanist historians, like Davidson et al., (1965), have however shown that Africa invented its own artefacts for survival and pleasure, independently from the rest of the world. This includes Africa's independent discovery of iron smelting (Davidson et al., 1965). The propagation of the "non-inventiveness" of Africa as a tag becomes, in the position of this study, a *systemic* and *institutionalised* affair, reflecting itself in various forms, such as; in concepts, principles, laws and theories, etc. and other narratives. An example can be seen from the just discussed evolving economic theories where the component of Africa is completely left out or treated with 'diminished confidence' as in the case with the NTS.

Institutionalisation will therefore need to be viewed with a much greater African perspective if it is to benefit the economy of African society, especially in its pursuit to technology creation. It is here argued that "imposition" of an existing institution by itself does not hold the remedy to Africa's underdevelopment. Its operation, efficiency, arrangement and structure could form the bases for a decision when it evolves from the culture of the local society or adopted and well assimilated.

3.3.4 De-institutionalising Institutionalisation

Institutions and institutionalisation have been credited by authors as the growth factor for the industrialised economies (Acemoglu and Robinson, 2012). This claim is here contested and this sub-Subsection argues that institutions are a product of culture and itself, a product of the society. Thus, institutionalisation should be considered to evolve culturally, as its appearance could differ significantly between different cultures. Economic growth will therefore be presented here as not being the outcome of institutions as perceived from the western industrialised regions, but a combination of factors which are not necessarily foreseen.

Indeed, it has been shown by scholars that economic growth patterns have varied throughout history. Before the advent of the *industrial revolution* in the eighteenth century, [institutionalised] England could not compete in production with its Asian textile producing counterparts like India and China who could not be described then as institutionalised the same way (Goldstone, 2002). This is not to say, China had no institutions, but their arrangement and structure differed from those of the West, for example, the style of democracy practised in China is different. Such finding by Goldstone implies that the institutional framework that worked in India and China differed from what obtained in England at that time. It was the *industrial revolution* that set England's production ahead of the rest of the world with the invention of the steam engine and other developments (Downs, 2010).

It is however noted that economic growth in England was slow at this stage of industrial heights (Goldstone, 2002, Williamson,

1984). In today's world, it could be argued that China cannot be described as being institutionalised in the same way as the UK (Newsweek, 2009, Thornton, 2008), yet it has such high economic growth rate (Bosworth and Collins, 2007) as the second leading economy in the world only after the US (BBC-News-Business, 2014). This therefore suggests that institutions do not necessarily need to be formed or fashioned as it occurs in a place and be implemented the same way elsewhere with different cultural background and interpretation.

Thus, institutions should be allowed to evolve from the culture of the society, but this was not found to be the case with Ghana. Bureaucrats in Ghana simply replicate what was handed down to them by their colonial predecessors (Price, 1975). Therefore, Ghana's approach at replicating the western form of institutions may need to be reviewed within cultural context sensitivity with technological growth at hindsight.

3.4 Emerging Economic Concepts for Technology Development

As previously shown, economic theories have evolved over the years and centuries since the days of Adam Smith in the 18th century with his famous publication of, *An Inquiry into the Nature and Causes of the Wealth of Nations* (Smith, 1776), commonly called, *The Wealth of Nations*. In this treatise, Smith puts forward the economics of the free market system, where market forces are determined by the natural laws of demand and supply. That is, a system where the market regulates itself not, requiring any conscious input or manipulation by, say,

government, but it is controlled by the *invisible hand* (as understood from the work of Johnson et al., 2003).

Such free trade and liberal economic theory was found to fall short when it became apparent that government intervention was sometimes required to stir demand to keep the market going. As other economic theories developed, the German economist, Friedrich List, argued the need for government's conscious involvement in the market forces, directing and intervening to attain desired economic outcomes.

Scholars of the subject describe Friedrich List's work, of *national system of political production* (List, 1841) as being focused on developing a system of production for Germany by taking on the approach of 'developing the productive forces rather than on allocation issues' (Lundvall, 1992/2010, Lundvall, 2007, Freeman, 1995). List's alternative view to Adam Smith's theory pointed to the need to build national infrastructure and institutions in order to promote the accumulation of *mental capital* and use it to spur economic development (Johnson et al., 2003). This suggests a conscious effort, using government involvement, to build the then German national economy through the development of technology to catch-up with the relatively more advanced technological capability of England at the time. This is seen as a deliberate conscious effort of the German nation to build their economy on technology, by focusing on developing and deploying technology for economic growth. Lists' approach took on board a wide range of national institutions such as education, transport, and other national infrastructures to work as a network towards enhancing higher productivity (i.e. development towards productive forces).

Germany today can no longer be considered as needing any catching-up strategy, but Lists' idea was considered to be relevant in today's age of rising industrial disputes over economic, environment and general global *sustainability* and development concerns.

Using List's idea, Christopher Freeman presented his work to the science, technology and competitiveness group of the OECD (Organisation for Economic Cooperation and Development) group of nations. His work was on a "new" approach to *technological change* to reduce its destructive impact on the environment without destroying its economic base (Freeman, 2004, Freeman, 1982). The new approach entailed government involvement in promoting technological infrastructure and circumstances under which free trade could boost economic development (Johnson et al., 2003). Freeman's work was however considered by the OECD to be too provocative to be accepted, mainly due to its non-neoclassical framework, that is, it advocated government (national) intervention (Lundvall, 2007, Sharif, 2006). His work was seen to oppose the free market concept of an *invisible hand*, the laissez-faire approach, hence, rejected.

In fact, such conscious approach, as suggested by Freeman, defines the technology policy seen in Japan, Taiwan and Korea (Lundvall B-A. and Borras, 2007) to catch-up with the technology leaders.

It was the work of Freeman and his collaborators, using List's theory (Freeman, 1995, Freeman, 1987) and Lundvall and his collaborators, based on Schumpeterian work (Johnson et al., 2003, Lundvall, 2011) that led to the new and still evolving concept of National Innovation system (NIS).

The *NIS* concept, as earlier demonstrated, was developed to provide an alternative approach to the *neo-classic* theories, which considered technological innovation as exogenous to the economic (production) system and not as a component that determined the competitive advantage of the firm. The neo-classical theory conveys the notion held in those early days of Adam Smith, when [scientific] discovery and [technological] innovation was sporadic. But in today's business world, firms compete on innovative capabilities – how quickly you are able to turn out a new product to the market and this is controlled by technological change. As such; *NIS* is used as an analytical framework to explain competitiveness, economic growth and development based on technology creation and product innovation through learning (Freeman, 1995, Lundvall, 1992/2010, Lundvall, 2007, Grossman and Helpman, 1994, Schumpeter, 1942).

Gertler (2004) argues that, learning between firms as expressed by the *NIS* is only possible when there is a deeper understanding shared among the learning partners based on basic cultural commonality. This was explained to be due to the tacit and context-specific nature of firm's innovative data (Gertler, 2004). Gertler went on to show that economic behaviours are embbeded in regional cultures.

It has generally been observed by scholars that traditional theories in economics do not adequately capture modern economic trends considering technological innovation and the role of institutions (Chang and Evans, 2000, Johnson et al., 2003, Szogs et al., 2009). Similarly, with reference to developing economies, the approach to obtaining technology remains elusive,

as those with the technology and providing the concepts for its creation speak from their own cultural background (Chevalier et al., 1992, Gertler, 2004). This explains the difficulty experienced in technology transfer to developing countries.

Besides, on the same trend, developers of the innovation system see NIS application in developing countries as very problematic despite the required institutional set-ups being there (Johnson et al., 2003, Szogs et al., 2009). Growth in the developing world remains a concern to economists who are now turning to technology; that improvement in technology is the best chance to overcome the apparent limit to growth (Grossman and Helpman, 1994).

The concept of the *Innovation Systems* does not however claim to answer all economic development questions as pointed out by Johnson and his colleagues, who posit that; 'the application of the innovation system concept on economic development makes more visible some general weaknesses of the concept and gives strong incentives to develop it further' (Gertler, 2004)-(pg. 5). Thus the whole process of innovation is shaped by the social (culture, behaviour, customs, etc.) and institutional contexts of a regional location (ibid).

Economists now recognise technology as an intrinsic factor for growth and its absence in the developing world as well (Lall and Kraemer-Mbula, 2005, Muchie, 2011, Muchie et al., 2003, Juma, 2011), but have not been able to identify or propose the means to obtain it besides acquisition and adaptation. This therefore sets the challenge for this study.

3.4.1 Existing Development Models

Analysts have approached the challenge of technology "availability" to the developing world from the perspectives of the expanding NIS concept as mentioned. These include, for example; the early proponents of the NIS concept, based on a 'learning principle', where firms learn from each other as noted among Japanese firms (Freeman, 1987) and based on economic policy theories influenced by Schumpeter's work (Lundvall, 1992/2010). They learn to innovate – learning as a principle, where linkages between firms and related institutions are well defined. List's work of the role of the State (Freeman, 1987) forms much interest in this study leading up to the significance of innovation.

Innovation, here, being represented as embedded within the larger society, which invariably comprises of and influenced by local/traditional institutions, cultures, rules, etc. in the commercialisation of technology (Godin, 2009). The social contextual approach, advocated for by Geels (2004) provides an analytical distinction between technology systems and institutions, but falls short of the issue of technology – in creating the artefact – the niche in the regime. Johnson and his colleagues outlined the application of the concept to developing economies (Johnson et al., 2003), but, not a framework for developing countries obtaining their technology. To give a deeper understanding on the NIS concept to the position of developing economies, Astrid Szogs and his collaborators focus on 'learning' linkages between small-to-medium enterprises (SMEs) (Szogs et al., 2009), which forms majority of firms in the developing world. For their grass-root nature and large numbers, SMEs are seen to

provide high potential of hope for success in sharing knowledge quickly and effectively to boost business. How technology flows to these enterprises remains somewhat elusive. Similarly, clustering of firms holds the advantage of transforming low tech industries to promote tacit knowledge (Myltelk and Farinelli, 2000), which would strengthen the knowledge base of the local businesses, as domestic producers face high competition from abroad. To further enhance this learning process for local producers, a technical training scheme to interface between academics and industry is put forward (Muchie et al., 2003). Several supporting suggestions are made, but, it appears persistently difficult for scholars to come out upfront, on how developing economies could establish a reliable control over their technology source, looking at the option of generating and retaining its blueprint.

At the moment, the solution proposed by scholars is for the developing countries to acquire foreign technologies, absorb them, adapt and improve upon them constantly as conditions change (Lall and Pitroballi, 2005, Lee et al., 1988). Large volumes of well-intended publications, providing extensive analyses and suggestions to enhance technology for the developing world have been produced. There remains however, to be seen an African country which has been able to cross over the threshold of technology bottleneck using any of these models, of which, none have proven to be successful.

Reviewing the discussion developed so far, it can be observed that the concepts and proposals originate from scholars in the developed countries, extending the goodwill of their knowledge to the developing world. It can be seen that the work of the

scholars leading to the development of the *NIS* concept was based on a framework of linkages between *institutions* as it is prevalent in their home society. These required institutions, like health, education, finance, construction, the court system, etc., have been identified to be replicated in the developing world through colonial relationship, but they are weak and ineffective (Johnson et al., 2003, Szogs et al., 2009). This inherent weakness is characteristic of African nations. It could therefore be argued here that though institutions are necessary-presence for the growth and development of technology, they however should not necessarily be structured to appear exactly like those in the developed world, but rather their form should be based on cultural, geographical or historical reasons as earlier noted for emphasis.

CHAPTER FOUR

4.0 TECHNOLOGY PERSPECTIVES AND THE SUSTAINABILITY CONCEPT REVIEW

4.1 Introduction

This chapter considers how the growing body of knowledge perceives technology development, drawing mainly from the standpoint of other fields of study such as economics, sociology, history and other related disciplines in addition to technology development models from selected countries. In looking at technology from the analyses of these non-engineering subject areas, this chapter attempts to reflect on engineering (focusing mainly on manufacturing engineering), to identify its perceptions, analyses and discussions on the technologies it creates, with specific emphasis on highlighting manufacturing engineering devoted to issues of technology development for technologically deprived societies like the developing world.

This thesis, so far, has shown how developing countries (with focus on Ghana) could be characterised as having little or no domestic technology base, and as such, are heavily reliant on the industrialised world for their technological solutions. Their situation has received extensive analyses from economists, sociologists and historians alike, with the economists' analyses eventually leading to the emergence of the Appropriate Technology (AT) Movement and the National Innovation Systems (NIS) previously discussed.

These non-engineering contributions evolving into concepts and theories raise the question of what concept or approach is

'engineering' putting forward to address the question of technology drawback in developing countries. This chapter further emphasises that environmental, economic, social and cultural *sustainability* should be the hallmark of any approach that may be developed from the engineering perspective. Also, to serve as examples for developing countries, models of technology development from some selected countries will be discussed.

4.2 Technology Perspectives Across Selected Fields of Study

4.2.1 Introduction

Economic theories addressing technology discussed in the previous Chapter leaves more work to be done as to how to manufacture these technologies and its innovations in a developing country context. This section therefore hopes to provide a highlight of perspectives towards technology, beginning with a summary from the economics viewpoint already discussed to allow for flow in the discourse. Perspectives from other fields of study, especially in sociology, will also be discussed. Engineering, with particular focus on manufacturing engineering, will be looked at to ascertain its contributions to commenting and discussing its work of technology creation. It will be seen that, engineering itself has not given much attention to the discussion of its work as no offshoot was found addressing, for example, the issue of how to manufacture needed technologies for technologically deprived societies. Such offshoot may lead to a new concept, probably called, *development engineering* for

technology creation. Recall from the last paragraph of Section 1.1 that, proposal of the concept of development engineering is deferred for future studies elsewhere.

Manufacturing (i.e. manufacturing of technology) here is seen as relevant to a national economy. However, because of the technologies it creates and the impact these technologies have on human life and businesses, its interest (discussions and analyses) spreads beyond the fields of engineering. This has brought about changes to traditional subject areas like *classical economics* as discussed above (see Section 3.4 of this thesis), which treats technology as exogenous in its theorems. Indeed, discourses on technology has been found leading up to new and expanding concepts, which incorporate technological innovation (Bergek et al., 2008, Johnson et al., 2003, Lundvall, 1992/2010, Sharif, 2006).

Different traditions in the theories of economics nevertheless, oppose each other disagreeing in contents and principles as new theories evolve. It is however argued that economists actually do not disagree on the fundamental principles of economic theories. Where contentions arise is when applying the details, in other words, when trying to focus the larger picture onto the smaller screen (Weintraub, 1985). Some of the controversies in approaches put forward for economic development by the progenitors of classical economics (Marx and Engels, 2013) were, for example, highlighted by the developers of marginal economics such as the work of Irving Fisher (Fisher, 1906) and others. This branch of economics claimed that classical economic theories did not reflect the 'value' of the price people would pay for a commodity, but was based on the balance of its demand

and supply till saturation occurred (Weintraub, 1985). The saturation theories of marginal economics eventually evolved into neoclassical economics, which works with, 'economic agents' which could be households or firms. These agents are conceptualised as 'relational actors' modelled for optimisation'. The theory asserts the essence of technology and science in economic development (ibid), but does not explicitly lay out its new approach until development economics emerged broadening the scope of 'economic agents' as institutions, hence, the concept of institutional economics and national innovation systems (Lin and Nugent, 1995, Lundvall, 1992/2010, Lundvall et al., 2001, Szogs et al., 2009). This is subsequent to the *intermediate technology* approach (Schumacher, 1974) (See chapter 3).

This new approach to the evolving development economics is perceived by modern economists to be most beneficial to developing countries as it takes into consideration the value and influence of social capital, such as custom, tradition and culture (see Chapter 2 of this thesis). These are seen to characterise the African economic outlook (Lin and Nugent, 1995).

Discussions developed in previous chapters of this thesis (Chapters 2 and 3) have shown that these economic development approaches have not been able to translate into economic growth for Africa. They also neither explain the low or absence of growth (Aryeetey and Fosu, 2008, Frazer, 2005, Teal, 1998) in relation to the presence or absence of a technology development interface, hence, technical growth.

In view of such problems, Sachs' (1992) description, looking at a UN record, sums it up. He notes as follows:

> *...a problem compounded by cyclical factors, borne most heavily by the third world* (Sachs, 1992)-(pg. 307).

A proposed solution put forward by Sachs to the disappointing outcome of relying on 'monodisciplinary approaches' in development economics was that;

> *A restructuring of the development paradigm is called for, debunking the conventional development economics and transcending the mystifying distinction between economic and non-economic factors introduced in a simplified, if not caricatural, way into formal deductive models* (ibid, pg. 313).

Thus, taking the position of the author to debunk conventional development economics, this study therefore seeks a pragmatic approach to creating technology, which incorporates the concerns of socio-cultural-techno-economic development. This invariably might lead to a new approach from the engineering perspective looking at technology development on the pragmatic stance of sustainably manufacturing its technologies. To build the engineering position may require the perspective of other fields of study besides the efforts from economics.

4.2.2 Sociological Perspectives to Technology

Looking at technology as being relevant to a national economy alone could be perceived as underestimating the extent of its influence and the relationship it creates between humans and artefacts. Such consideration has been broadly expanded by the actor-network theory (Prout, 1996) popular among sociologists,

especially those of the science and technology studies (STS) cohort.

Human life on the whole is often seen to be intertwined with technology so much so that existence without it cannot be perceived (MacKenzie and Wajcman, 1999). As such; technology is sometimes viewed as a separate entity outside of society with which to interact (ibid), i.e. an object that society is dependent on and must adapt to. Sociologists have however been able to put forward explanations from arguments and counter arguments, challenging such narrow perception and broadening the scope to defining technology as being a constituent part of society, influencing it and it being influenced by the society in turn. This line of reasoning sets the ground for the *Social Shaping of Technology* (SST) developed (Hughes, 1987, MacKenzie and Wajcman, 1999, Williams and Edge, 1996).

Pantzar (2010) sees the work of SST as a non-deterministic model of technology change. Indeed, MacKenzie and Wajcman (1999) agree with this position, pointing out that technology determinism (Ogburn, 1938), which in effect asserts that technology accounts for the development of a society, is an oversimplified representation of the overall picture. In the determinist's view, according to the authors, technological change is perceived as an independent factor impacting on society from outside of society. SST therefore claims to provide a holistic approach of looking at technology which is actually shaped by a range of social and economic factors, including technological factors, as in, technology shaping of technology (MacKenzie and Wajcman, 1999, Williams and Edge, 1996).

In a discourse, this study, trying to understanding technology as a construct of human society, as put forward by SST, raises the question of where to place the limits of society. That is to say, when the question is viewed against the backdrop of technological development, how far does social determinism define the bounds and limits of technology advancement, deployment and acceptability? In other words, is it economy, or technology embedded in society or vice versa that plays the leading role? In fact, this argument seems limited to technologies where society is the user. The rule does not appear applicable to use of technology at firm level. More so could it not be argued that technology sometimes develops outside the purview of society before it is later recognised and *accepted* (or *rejected* as the case may be)? For example, the automobile was initially rejected, but has now become an invaluable part of family life (though it is also highly criticised for impacts on social life, health, local and global environment pollution, etc.), just as the contraceptive was rejected when first introduced, but has now become an artefact of significance (Edgerton, 2008). These and other technological artefacts have invariably determined the picture of modern society and in fact have marked the evolution of human civilisation (Khalil, 2000). Probably, owing to such obvious presence of technology, SST recognises technology as an active shaping force in its development (MacKenzie and Wajcman, 1999).

This position by the authors whose work supports social determinism as opposed to technology determinism looks more like coming to a compromise with technology determinism, at least in this area by stating that 'there is no single dominant shaping force'. By such statement, the authors invariably are

agreeing with technology determinism probably to avoid a complete collapse of the theory of social determinism (i.e. SST), as the politics of artefacts (Winner, 1980) could actually be a complex network.

SST in its build up could however be seen as providing a perspective for alternative analysis and discussion of technological change, but as it logically reverts to the prominence of technology as the force to reckon with, this discussion will place more emphasis on the pursuit after technology. Thus, technology could be described as exhibiting 'power' over society, and, society impacting its level of influence in determining its *acceptance* or *rejection*. Its acceptance or rejection however does not inhibit technology creation, as it may be seen from the work of Edgerton (2008) that several technologies created have not been commercially successful. The argument here therefore is that its commercial success or failure should not be seen as necessarily socially determined, but could be the result of other technical factors like marketing techniques or time of release, etc. As such, the failure does not preclude the technology being made (manufactured).

4.2.3 Technology Discussions in Manufacturing Engineering

As we have seen so far, discussion of technology, spans the fields of Sociology (Bijker and Law, 1992, MacKenzie and Wajcman, 1999, Prout, 1996, Williams and Edge, 1996), Development Economics, Political Economics, etc. (Lall and Kraemer-Mbula, 2005, Lall and Pitroballi, 2002, Lin and Nugent, 1995, Schumacher, 1974), to its new emerging concept of

National Innovation Systems (Freeman, 1982, Freeman, 1995, Lundvall, 1992/2010, Szogs et al., 2009), and others such as History of Technology (Edgerton, 2008, Singer and Williams, 1954, Austin and Headrick, 1983), Geography of Industrial Practice (Gertler, 2004), and others not explored. But its discussion and expansion is not visible in the extended fields relating to Manufacturing Engineering such as; Operations Management (Hill and Hill, 2012), Operations Research (OR) which, evolved from Management Science (Hillier and Lieberman, 2001, Winston, 1994). These could be described as offshoots of manufacturing engineering during the boom of factory productions (ibid), most notably during the Second World War (Edgerton, 2008).

This study was unable to find in its search for new expansions (off-shoots) in manufacturing engineering directed at seeking technological solutions for technologically less endowed economies, like developing countries. Manufacturing engineering seems to be concerned mainly with optimising shop floor operations and improving on efficiencies, leaving the discussions on the topic of technology to other fields of study mentioned above.

For example, Operations Management and its associated fields of production systems have been concerned mainly with improving efficiency to enhance optimal production in manufacturing and its peripheries such as the supply chain system, financial function, transport, etc., (Groover, 2011). It has been able to achieve this by developing a number of concepts and philosophies such as those found in management science (motion study, time study, etc.), just-in-time principle, lean production (ibid), concurrent

engineering philosophy (Jo et al., 1991) used to reduce design time, etc. These developments do not necessarily stand to address technology development issues in, say, Ghana as they lack the necessary background and philosophy to develop a system (model, framework, approach, principle) for technology development (manufacturing, deployment and growth).

Since the focus is mainly on manufacturing of the needed technologies, it will be helpful for the discussion to have a common ground of understanding as to what manufacturing is, as it applies to this thesis.

4.2.4 Defining Manufacturing and its Economic Relevance

The term manufacturing is so variedly used that it means different things to different people. This sub-subsection will attempt to construct a common understanding for this discussion.

When speaking on the subject of manufacturing, in most cases, the first things that come to mind as examples of manufactured products are cars, computers, mobile phones, etc. These are clearly examples of manufactured goods, but in principle, the term "manufacturing" is not limited to these goods alone. Literally speaking, every object that forms part of the human material world is obtained through manufacturing, except for naturally occurring events which are unaltered and in their natural state or condition. Thus a term broadly used by different fields of study, manufacturing lends itself to its differing interpretations. The engineering perspective becomes of interest here.

The word 'manufacture', according to a professor of Industrial and Systems Engineering, Professor Mikell Groover, in his work, 'Principles of Modern Manufacturing', is derived from two Latin words; *manus*, meaning hand, and *factus*, which means to make (Groover, 2011). In other words, to manufacture simply means to *make* [something] by *hand*. This original meaning of the word is shared by a number of authors, one of who is Creese (1999). This meaning fits every society and culture, as peoples everywhere need to make the things they need to survive on, e.g. baskets, canoe, chisel and hammer, etc. through to more sophisticated products like combined harvesters, ships, computers, cars and so on.

Manufacturing today is however, no longer limited to making things with the hands alone. Having moved on from the "making" of things only by hand, tools and other machines (systems) for manufacturing have been developed (manufactured) and used in many areas of production to convert raw materials into finished products (Chryssolouris, 2006, Creese, 1999, Kaebernick et al., 2003b). These systems (the technologies e.g. machines, robotics, etc.) employed in the manufacturing process will be referred to, in this study, as *manufacturing technology* (the technology used in manufacturing).

Groover (2011) has elaborated upon the technological and economic perspectives of manufacturing by denoting the technological perspective as the application of physical and chemical processes to alter the geometry, properties, and/or appearance of a given starting material. The economists' perspective was the adding of value to a material by changing its

shape or properties. This was previously expanded by Friedman (2006), who views manufacturing as a wealth-producing sector of an economy. The picture being painted here supports the notion that *manufacturing is essentially a means to technologically alter a material into a finished (value-added) product to suit the need of the market (customer/user) with the potential to create wealth*. It can be seen that both perspectives aim at different objectives; the engineering perspective of manufacturing is concerned with the processes involved in meeting physical needs, while the economist's perspective is focused on the economic value to be gained. The economists' stance detaches from how the product is made, while the engineers' concern is how to make the product, thus, the manufacturing of a finished product. The product could itself be a technology to be used for the manufacturing other products, that is, manufacturing technology.

4.2.5 What is Manufacturing of Technology

It may be noted here that the *manufacturing of technology*, which is the focus of this study, is not limited to the term, manufacturing technology. In essence, manufacturing technology encompasses the tools, knowledge and techniques by which all manufacturing and productions are made possible (AMT, 2013, Khalil, 2000). Manufacturing of technology on the other hand, is the process (the verb) of making (manufacturing) the technology and it is mainly concerned with using these tools, knowledge and techniques (i.e. using the manufacturing technologies, which is the noun) to manufacture all the needed technologies, including the technologies used for manufacturing, i.e. the manufacturing technologies. Thus the terms;

manufacturing of technology and manufacturing technology which recur in this study, should be considered as distinct terms.

4.2.6 Differentiating between Manufacturing and Production

The terms manufacturing and production are very similar in meaning, and are often used interchangeably. Groover (2011) for example sees production as having a broader application than manufacturing in the sense that one could say, 'the production of crude oil', but would be incorrect to say; 'the manufacture of crude oil'. It is however accurate to say; 'the production of a car' and 'the manufacture of a car'. These examples however do not provide detailed explanation as to the difference in their meaning and usage. In the opinion of Creese (1999) and Kaebernick et al., (2003) the difference in both terms has to do with geographical location, thus manufacturing engineering is used by the Americans, while production engineering is the preferred choice for Europeans and Japanese. This line of differentiation is too simplified and cannot be used to explain Groover's examples; neither did Groover himself give any further explanation to differentiate both terms beyond the example presented. An attempt to clarify the difference between manufacturing and production is made here.

Recall from Section 4.2.4, that manufacturing does not occur freeing in nature, i.e. everything around us, which is not a naturally occurring event is manufactured. Hence, using Groover's example as a point of departure; crude oil is a naturally occurring material; hence, it cannot be manufactured. The process of its extraction (production) however requires the

use of technology and technology generally has to be manufactured. So, manufacturing creates (makes, produces) the technology and the technology is used in the production (extraction) of the crude oil. In other words, one can also say, technology is produced through manufacturing, but not vice-versa, i.e. it will be incorrect to say, technology is manufactured through production. That is to say; we manufacture 'something', say a machine, and use it to produce things (replicate or produce products).

Expounding further on the example, it could be said that in the modern manufacturing of an automobile (or the production of an automobile), the various components that make up the automobile will need to be manufactured (or produced) individually using its specialised and dedicated manufacturing technology. Recall that this manufacturing technology (which could be a mould, a press, robot, etc.) will be used to produce the various components. This can then be [re]produced in large quantities (for interchangeability). That is to say, due to the requirement for large quantities of standardised parts, manufacturing these components individually will not make the car production cost effective. As such, a technological piece of equipment (the technology) is manufactured (or produced through manufacturing) and used to produce (to reproduce, to replicate) the specific part or a range of parts in large quantity (mass production) based on the principle of interchangeability (i.e. producing identical parts with exact dimensions and features). These mass produced interchangeable parts will be assembled together (assembly line production) to build the required automobile to specification.

Put in a different form, as understood from the Association for Manufacturing Technology (AMT, 2013); manufacturing creates the means for production to take place, whereas production is the churning out ('pouring out') of the manufactured product or system using a technology designed and manufactured for that task. An illustration of this is; a mould is manufactured[1] and used to cast (produce) engine block. That is to say, the mould is manufactured or made to be used to produce engine blocks by casting, hence, the production of engine blocks (not manufacturing) is by using the mould. Using production therefore, any quantity of equal dimensioned engine blocks could be produced (interchangeability). So, in as much as the two terms are used interchangeably, they actually carry their specific identity in meaning.

Setting out the difference is imperative to this study, as the aim of the study may not be achieved if the term, manufacturing is misconstrued to simply mean production. The above explanation, as understood from literature and scholars in manufacturing, is an attempt to present manufacturing as responsible for bringing a product into existence from scratch, i.e. it predates production, whereas production, on the other hand, comes in after the product has been manufactured, tested and approved for replication (Creese, 1999, Groover, 2011). Manufacturing therefore involves all the fundamental activities of research, planning, design, prototyping, prototype testing, manufacturing, assembly, disassembly, disposal/recycling, etc. Production,

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[1] The term 'produced' could be used as well, because tools are used to manufacture the mould, that is to say, the tools are used to produce the mould, bearing in mind that the tools are manufactured.

according to this study, simply replicates a product into the required standard and quantity.

4.2.7 Defining Technology

Manufacturing may be said to be the tool used to make technology, while at the same time, technology is used in manufacturing. Manufacturing may, however, be seen to precede technology in the sense that, technology will need to be manufactured first before it can then be applied in the manufacturing processes.

The definition of technology, according to Khalil (2000), is the application of 'knowledge, products, processes, tools, methods and systems employed in the creation of goods or providing services'. In this definition, Khalil has lumped all the components into one. On the basis of his definition, technology is understood in this study as the application of knowledge through laid down processes with the use of tools in the required methods to come up with the product or systems that will be used to produce a product or provide services. That is to say, the tools to be used could themselves be products or systems directed to an objective, i.e. production of goods or provision of services.

Groover defined technology as 'the application of science to provide society and its members with those things that are needed or desired' (Groover, 2011). This definition encapsulates all the processes and tools involved in the creation of technology. Thus, in this study, the term technology would mean any artefact, or product that has been manufactured, in other words; not in its natural state. This therefore implies that any item in its natural state of condition, once it has been modified by man for

use becomes a technological item. As such, technology is not limited only to highly efficient, complex and sophisticated piece of equipment, like wrist watches, mobile phones, jet engines, etc. but even simple tools such as table knife or spoon or the bow and arrow, are here understood to be technological artefacts.

4.2.8 Manufacturing Activities

Manufacturing of products in this modern era does not come about as a single occurrence. It involves certain activities even in its simplest form like being 'made by hand'. Take the making (manufacturing) of a simple tool as example, at least, the material for the manufacturing will have to be gathered, product to be manufactured need to be clearly laid out, there need to be the physical action in the making, etc. All these form part of the manufacturing activities.

Manufacturing, however, has not remained in its simplest form. As deduced from literature, its advances and complexities have meant that it is now carried out involving different stages of activities. Different authors identify these activities differently though with a common convergence. In conformity with the objective of this study and in commonality with manufacturing processes, the manufacturing activities identified are listed, as shown in Figure 4 below. They are here are considered to include, but not limited to the following: planning, design, supply chain, setup, manufacturing-production-craftsmanship, marketing and research. In addition to these is the product end life, what to do with it; recycle or dispose of. It is the duty of manufacturing, for sustainability reasons, to provide a clear guideline of its intention for the product's life span. These

activities need to be carried out under the consideration of the concept of the *sustainability* philosophy.

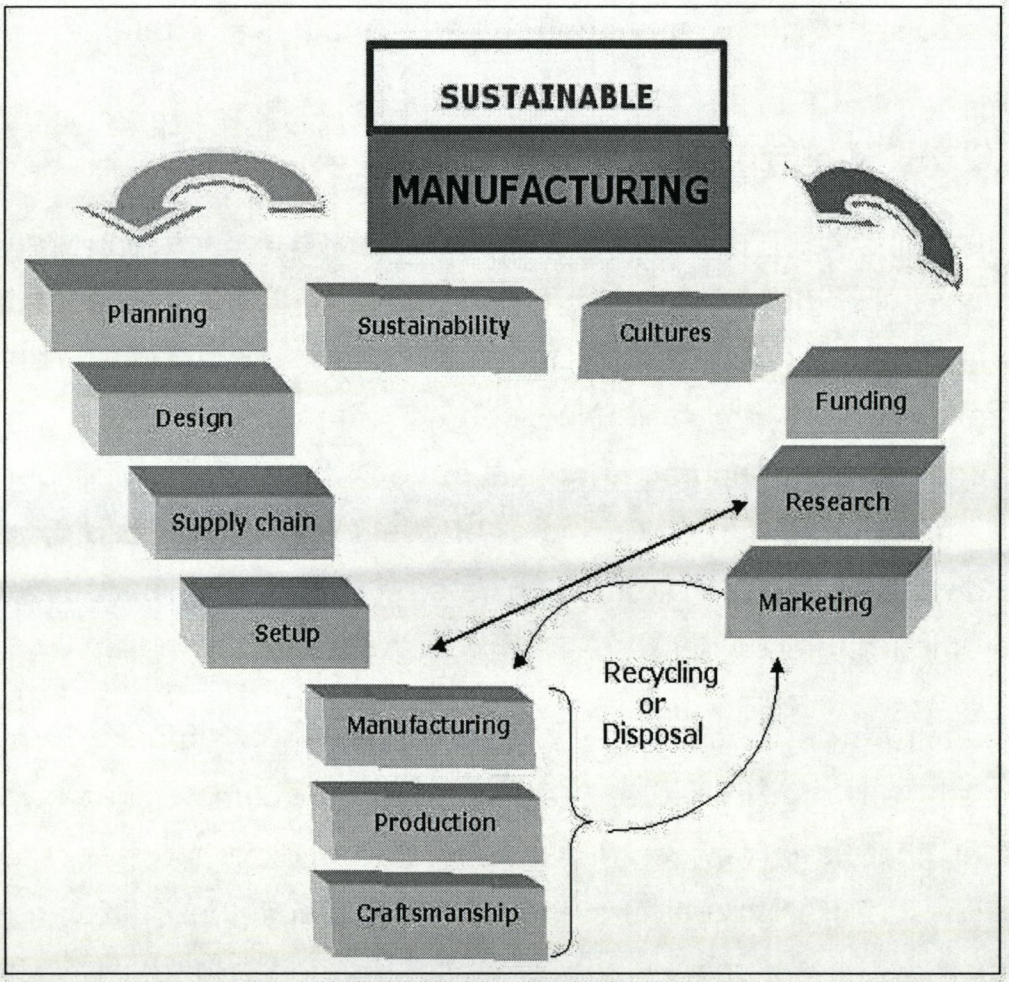


Figure 4: Manufacturing activity model constructed from literature (Source: Author)

Furthermore, this study assumes the position that manufacturing technology impacts on other professions directly or indirectly as their means to getting their tools and equipment to carry out their professional tasks. This can range from the office pin to the most sophisticated medical or scientific instrument. Figures 5 and 6 below attempt to show how manufacturing technology

relates to providing the products required in human society cutting across other fields of profession.

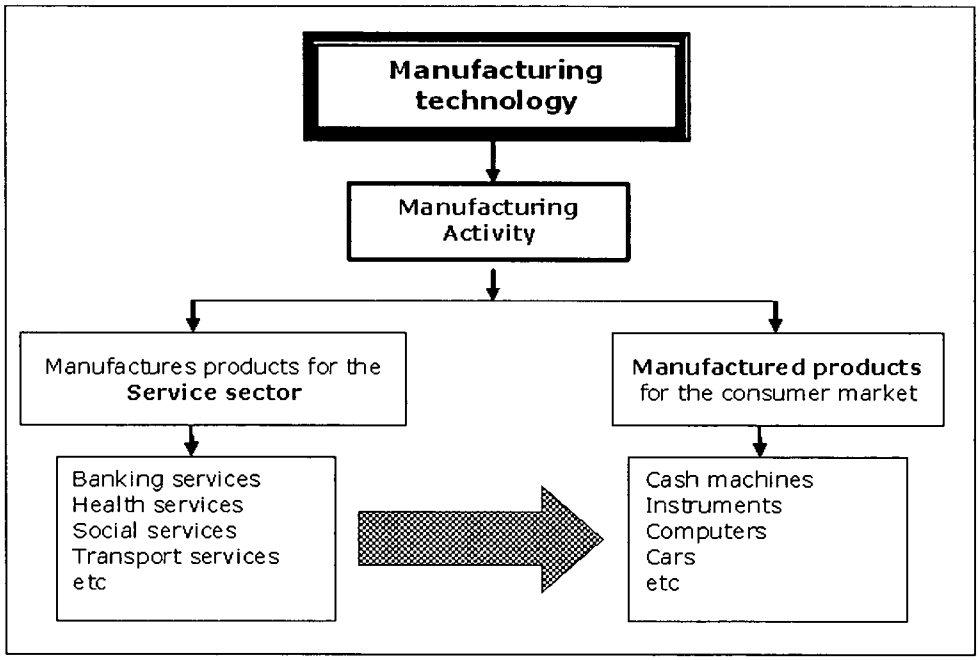


Figure 5: Manufacturing technology responsible for products in human society (Source: Author)

As can be seen from Figure 5 above, which shows manufacturing technology (MT), going through a manufacturing activity, is used to manufacture products both for the provision of services or as consumer goods. It can be seen from the bottom-left of the figure, how the service sector, like banking, health, etc., rely on the use of technological artefacts (machines, instruments, computers, etc.), as pointed by the arrow to the right box, to carry out their work. This emphasises the point that without these manufactured "instruments" and others, the profession and the service sector may not be able to adequately dispense its duties.

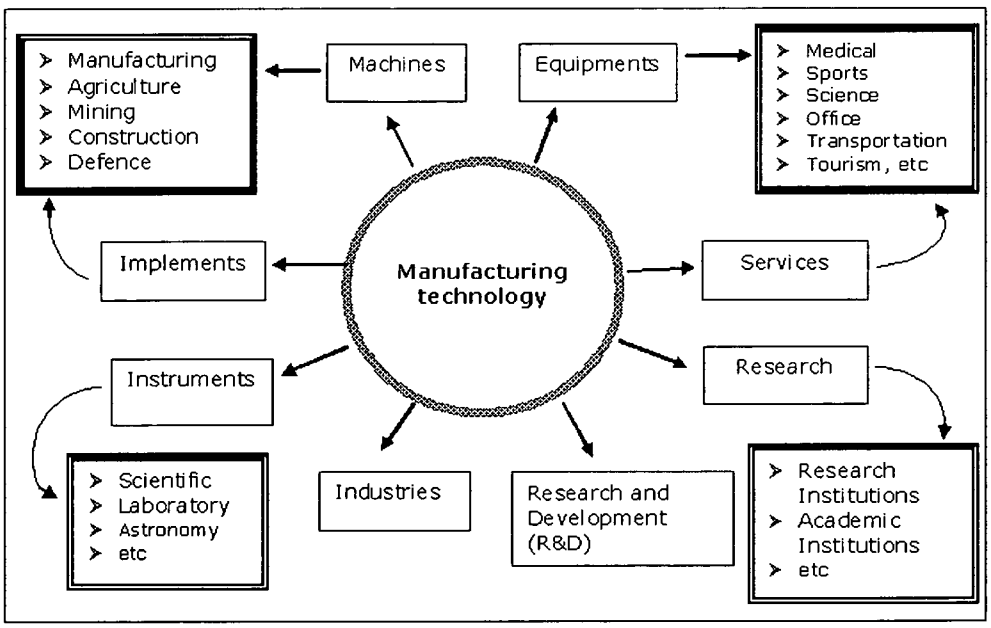


Figure 6: The centrality of manufacturing technology in society (Source: Author)

Similarly, Figure 6 above, attempts to depict the centralisation of the (MT) in all industries. For example, taking the looking at the contents of the four boxes at the four corners in the Figure, the central manufacturing technology is used to manufacture all the machines, tools, equipment, etc. for the various industries, including the manufacturing industry, agriculture industry, mining, medical and all the other industries.

4.3 Technology Development Models from Selected Countries

This section focuses on how technology-transfer to different places around the world from England (since the time of industrial revolution). That is how some selected countries through the spread were able to build their technological background and capability. This may serve as examples for Ghana.

There are extensive studies and historic records on the industrial revolution and its aftermath of technology transfers to the United States, Japan and other places in the world. To avoid a repeat of such far-reaching study, this discussion will not follow that line of reporting. Instead, it will draw attention to how some of these countries transformed their societal setting by assimilating into their cultural and social structure an industrial attitude. To build up the discussion, a brief historic overview will be helpful for the process.

Lundvall and Borras (2004) presented a brief account informed by the work of Yakushiji (1986), on how King Henry the Eighth of England developed a competitive production of cannons in the sixteenth century, prior to the famous industrial revolution. This was innovative at the time since the closest competitor and rival, France, was in a way, ahead of England and from whom England, having the advantage of possessing iron ore and the woods to supply the fuel, had to smuggle in the skilled forgers to enable the technology needed for the king to win his wars. History has shown how relevant England was to the formation of the modern

world since before and after the industrial revolution. As noted by Goldstone (2002);

> *Indeed, although it is far too early to call it a consensus, there is a growing chorus of voices that argues that (1) no other place in the world besides Europe was moving toward a modern industrial economy during the "early modern" era; (2) even within Europe, no other society besides Great Britain was moving firmly in that direction; (3) even within Britain, such movement was chiefly the result of a contingent and conjunctural pattern of events rising in the seventeenth and eighteenth centuries and not an inevitable development from earlier centuries of economic growth and prosperity; and (4) even in Britain any departure from earlier patterns of growth stretching back to the high Middle Ages is not evident until well into the nineteenth century* (pg. 332).

In a quick historic narrative, Edgerton (2008) showed how systematically technology was gradually disseminated to other regions of the globe, initially with technology transfers to the US and then to other countries like Japan, India, Korea and others. The account holds that these countries, especially the US took these technologies and began to develop their innovative capability such that...

> *...By the mid century, however, the USA was a clear leader in industrial research and innovation* (Edgerton, 2008)-(Pg. 112).

At the onset though, and during its early formation period, the US was importing technology from England and its early industries could not compete with its European counterparts. It was the outbreak of the Napoleonic wars that compelled the States to 'rely on its ingenuity to make all its products it needed...' (Jequier, 1976). This was why by the mid-century they were already world industrial leaders.

It can be distinguished here that there was an impetus of internal drive (local demand), acting as a catalyst to the development with, suggestively, no initial conscious ambition and efforts of catching-up or lead the world in industrial development. The development seems to have been driven mostly by a motivation gained in the knowledge of the good technology brought to their lives (Ogburn, 1938), making the difference between "living poor" and "not living poor". The American nation seems to have been able to overcome known barriers and restraining factors such as superstitions and fear (Tenkorang et al., 2011) and was focused on their technology course. Coupled with this was probably their knowledge that they had no other option, thus building their self-confidence in knowing that they had the ability (Sen, 1999) to pursue technology further to a next step, and then to the next step, and so on.

How best to describe this drive so as to replicate it in a developing country context is not known to this researcher yet, but what seems probable is a thought frame inspired by an author, that; a society whose structure is imbued with a consciousness and determination of unquestionable search for an objective is more likely to arrive at a point of definite objective

(Ogburn, 1938). This is very much applicable to the application of technological solutions to societal problems requiring the use of technology.

Similarly, albeit in a somewhat different approach, Japan developed its own path to technology innovation capability and growth as shown in the work of Lundvall and Boras (2005) and Edgerton (2008). The approach adopted by Japan was initially without that conscious effort, but as time went on, it saw the need to compete with the technological might of the United States and Europe (Edgerton, 2008). History has it that the Japanese soon got accustomed to the bicycles imported from England in those early days. The bicycle repair shops in effect, started turning out Japanese made models, which in reality though could be described as part-British-part-Japanese bicycles in a ratio of 9:1 (ibid). These bicycles were exported mainly to China and throughout South-East Asia (ibid). Working on similar premise, Japan went on to develop other industries like the electronics industry, which evolved from the radio and television repairs into innovations to reckon with. Over time, they had developed their own innovation system to adequately compete with the West.

It has become obvious to Japan at this time that it needed to adopt a conscious effort, a determined focus on technology innovation and development to achieve a competitive parity with its European and American predecessors. According to Lundvall and Borras (2005);

> *The motivation behind the technology policy in Japan – and later on in countries such as Taiwan and Korea – [was] driven by a national strategy aiming at*

catching up [with the West, as far back as the Meiji revolution] (Lundvall and Borras, 2005)-(pg. 608).

It could be seen how, taking the example of US and Japan, both countries developed from their initial background to high-technology through quite separate approaches. For the US, it was an issue of necessity, having limited imports from its English ally, due to the wars of Napoleon, while for the Japanese, it was a conscious effort to catch up with the advances seen in the West.

This was a similar case with Germany, as previously seen, wanting to catch up with England (Johnson et al., 2003) which was then leading in industrial capability. It was this quest of catching up that resulted in List's approach to economic development which advocated the need for government's involvement in the market economy (ibid). The German approach to technology pursuit developed into a manufacturing culture of interest here. This is mainly because it is the only country among the industrialised nations that was able to maintain a traditional level of manufacturing which was not swallowed up by the service sector. This taking over by the service sector might account for the decline in manufacturing activities that typically now describes the industrialised countries. For example, according to the CIA World Factbook, the industrial production growth rate for the UK is at a decline of -1.2% as at 2011 compared to 8% growth for Germany for the same year period (CIA-World-Factbook, 2014). This is even higher than China, 7.9% the current leading manufacturing country in the world (ibid).

Before taking a look to at the German manufacturing culture, the remarkable rapid economic growth of China, which has been based mainly on manufacturing deserves a looking at.

The Chinese approach (like that of India (Jequier, 1976)), as suggested by scholars, stemmed from a self-initiated system of technology development. To a large extent, it was based on production from the rural areas (ibid), thus relying heavily on the use of local materials and local knowledge combined with universal knowledge, a two-legged system. This was a concept described by the Chinese leadership as 'walking on two legs' (ibid). The term is used signifying the combination of using the local knowhow in conjunction with world standard principles and knowledge. China's current high economic growth spurred by manufacturing (Bosworth and Collins, 2007) could be credited to this 'walking on two legs' philosophy.

This walking on two legs philosophy, could be seen as combining indigenous knowledge and methods of production (or doing things) with external knowledge and advances in science and technology. In this regards, both traditional and modern systems of operation are made to work in tandem. By this therefore, traditional institutions might evolve culturally, situating its roots in the very fabric of the society.

4.3.1 Monoculturalism; a Feature of Industrialised Countries?

There is something obvious here in similarity with the American and Japanese approaches; it is the demonstration of an internally (national) formulated agenda with a determined focus to push forward a technology development plan.

All three societies, America, Japan and China or five societies; when England and Germany are included, all hold a common trait, i.e., they all have a mono-cultural base, at least, during those early periods of industrial experimentations and eventual technological growth. They all had one basic spoken language, if spoken language could be used as the means for cultural classification (Lewis et al., 2013)). In comparison, Ghana has been described as having seventy-nine living languages (Lewis, 2009b), not including the dialects.

Therefore, the question whether monocultural setting in a society is a fundamental requirement for technology development and growth now comes up. Addressing this question however would be a considerable deviation from the current line of discussion, as such; it will be deferred to a different study as already briefly mentioned in Chapter Two of this thesis.

4.3.1 German Manufacturing Culture Model

Germany, as featured in media, at the time writing this thesis, has been at the economic forefront and is seen as the pillar of and solution to the European economic crises (Jones, 2009, Lapavitsas et al., 2010).

While characteristically, manufacturing has declined across the industrialised world since the 1990s (CIA-World-Fackbook, 2013b), as earlier mentioned, Germany, on the other hand has retained its hold on exports to China (Financial-Times, 2010) and other parts of the world. This may explain the base for its strong economy when compared to other European nations like France, UK, Italy, Spain and others which have seen a fall in manufacturing in exchange for growth in the service industry.

Germany's ability to retain its manufacturing culture amidst the characteristic decline amongst industrialised countries is unique.

As mentioned, Germany not being included in the notable decline in manufacturing seen across the industrialised world is credited mainly to its stable manufacturing culture described by authors as a standing system called 'Mittelstand' (Blackbourn, 1977, Kocka, 1973, Muzyka et al., 1997).

Mittelstand, in simple terms are the small to medium size manufacturing firms in Germany, in some cases existing for generations. These firms, often family owned, though small, manufacture to world class standard. They are in fact sometimes world leaders in their field of manufacturing.

The Mittelstand system, as understood from scholars, uses the stakeholder model of corporate governance (Donaldson and Preston, 1995), which results in a strong balance of payment for the economy as surpluses are registered. It creates not only a sense of belonging among its staff, but also a sense of ownership to the corporation by all stakeholders. In this system, customer value is esteemed highly and the same customer respect is accorded staff, encouraging the contribution of new ideas to continually improve manufacturing and production processes. The philosophy here is based on continuously expanding their knowledge management system, which is critical for decision making (Blackbourn, 1977).

Ghana could take a leaf from the German model so as to establish a firm base for sustainable manufacturing. However, in looking at the German model to apply to Ghana, one has to be cautious of the variances in the cultural settings between the two

societies as they have high considerable cultural differences. Germany, for example, may be described as a monocultural society when using number of languages as the basis for measuring disparity (Lewis 2009). The communication barrier, in the case of Ghana, will not be limited to differences in spoken language only, but the language differences may act as demarcation to cultures, which invariably accounts for the different way people view and understand the same issue (Hofstede, 1984).

4.3.2 Ghana-Malaysia Comparison

The case of Malaysia is important in this discussion because, Ghana and Malaysia have a lot in common (see Table 1) since after the Second World War. Both countries were colonised by the British, had similar economic outlook, with almost equal population and labour force. Their climatic conditions are both tropical and coincidentally both countries gained independence in the same year, 1957 (CIA-WorldFactbook, 2013c).

In spite of these similarities, Malaysia has been able to develop its industrial capability and is much more technologically and economically advanced compared to Ghana (ibid). Extensive work on the comparison is provided by Asare and Wong (2009) where, among other things, the authors highlighted political stability as the main factor accounting for the success in the Malaysian economy. The assertion, though true, is rather too superficial in the context of this study. This did not take account of the overall Ghanaian societal structure of mixed cultures as discussed in Chapter 2 of this thesis in comparison to Malaysia's only three languages spoken, hence, three cultural groups.

Table 3 below is presents some data obtained from the CIA World Factbook which shows statistical similarities and differences in both countries.

Table 3: Comparison of Ghana and Malaysia

Sr/ No.	Comparison Item	Ghana	Malaysia
1	Date of Independence	6 March, 1957	31 August, 1957
	Climate	tropical	tropical
2	Labour force 2009	10.33 million	11.38 million
3	Population 2010	24,339,838	28,274,729
4	GDP PPP 2009	$35.83 billion	$383.6 billion
5	GDP Official exchange rate (2009 est.)	$15.51 billion	$191.5 billion
6	GDP per capita (PPP) 2009	$1,500	$14,900

Source: Data obtained from The World Factbook dataset

From the above Table, one can clearly see the large difference between the two, supposedly similar countries. For example, in 2009, while Ghana's purchasing power parity (PPP) was $35.8b, that of Malaysia was $383.6b even though there is not much difference in the labour force, climate and population, yet, the difference in output is very large. And only 13% of the labour force is into agriculture as compared to 56% for Ghana (CIA-WorldFactbook, 2013c), yet they are not seen to have food crises.

The temptation not to compare both countries is difficult to dismiss for their close similarities. However, in comparing both societies the differences in their settings should be taken into

consideration. Malaysia is set within an economically and technologically vibrant region of South-East Asia, often referred to as the Asian Tigers. Countries in this region may not be deeply divided on grounds of cultural differences among their ethnic groups as is the case with Ghana. More so, they are also characterised by high level industrial productivity (Lall and Kraemer-Mbula, 2005), which could be seen as beneficial to member states like Malaysia. Unlike Ghana, where member-ECOWAS countries, or Africa in general, are characterised by low productivity rate (Lall and Pitroballi, 2002). Thus, the development of the sub region could be seen as a major contributing factor to a nation's development agenda.

Furthermore Malaysia, as has been noted, did not just sit back and the economic growth of its region translated automatically into its advantage. It worked with concerted policies to attract foreign direct investment (FDI), adopted an import substitution industry (ISI) approach, a free zone policy and prepared abundant cheap labour to feed the industries (Jegathesan et al., 1997). With these policies, it was able to expand its economy to become an export oriented nation as it continued to grow (ibid).

In comparison, Ghana, it may be recalled from Chapter 2 of this thesis, in its efforts during the early stages to industrialise its economy adopted similar industrial policies, but, as shown by scholars, all those strategies failed to generate any correspondent growth in the industrial [manufacturing] sector. The very method that worked for Malaysia, when applied, did not work well for Ghana. This therefore, makes this study even more relevant. Indeed, the case of Africa is unique; the African

problem of technical change is known to defy all known approaches geared towards solving it for good.

4.4 Overview of the Sustainability Concept

The concept of *sustainability* has received much attention and a wide coverage around the world from politicians to the media, scientists and business groups (Dodds and Venables, 2005, Moon, 2007).

It was the concerns of environmental pollution and the degradation of the ecological system on which the continuity of human survival depends that first initiated a search for control measures which led to the development of the concept (O'Brien, 1992, World-Commission-on-Environment-and-Development, 1987). This concept has rapidly evolved to include social and economic considerations (Herrmann, 2004, Sutcliffe et al., 2009).

World leaders have become alert to the repercussions on the lives of present, as well as future generations if human activities are not controlled. As a result, efforts were made to reverse the situation (if it were possible). The greatest cause of the pollution was blamed mainly on conventional manufacturing processes (in this case, not considering running systems like the automobile or domestic appliances) (Dodds and Venables, 2005). One corrective action suggested to mitigate the impact of conventional manufacturing processes is the concept of Appropriate Technology (AT), which was originally proposed for the developing world, but now considered by the industrial world (Huesemann and Huesemann, 2011). Also see Chapter 3 of this thesis for discussion on AT.

The awakening of world leaders to the environmental problem led to a series of world summits which eventually gave birth to a definition of the *sustainability concept* aimed at global sustainable development. This new approach to development was defined as 'meeting the needs of the present without compromising the ability of future generations to meet their own needs' (O'Brien, 1992, World-Commission-on-Environment-and-Development, 1987). The concern for preserving the earth's resources for the future generation marks the difference in human history from conventional production activities. Thus, this is calling for a fundamental change in corporate culture and business planning. It requires a 'shift in manufacturing processes from cleaning technologies to clean technologies which reduce the actual level of emissions produced and the energy and other resources used during production process' (O'Brien, 1992). How practicable this fundamental change could be implemented in the context of a developing country is unclear as there is large disparity, in terms of living standards (wealth), between the industrialised world and developing countries that are aspiring to industrialise their economies.

The concept actually began its concrete formation after the popular Brundtland Report called 'Our Common Future' by the World Commission on Environment and Development (WCED) in 1987 (World-Commission-on-Environment-and-Development, 1987). The report brought to light the harmful impact human (industrial) activities had on earth's resources and the environment in general. In accordance with the WCED, the Earth Summit in 1992 was held in Brazil by the United Nations Conference on Environment and Development (UNCED), which brought in the Rio de Janeiro Declaration and subsequently, the

adoption of Agenda 21 (United-Nations, 1992a). The declaration, which is a voluntary action plan, sought to foster a global partnership to address pressing global problems, thus, spreading the remit beyond environmental pollution concerns only to include other areas like poverty reduction, health care, illiteracy eradication (United-Nations, 1992b). Agenda 21 (the Agenda for the 21st century) continues to expand adding on more initiatives. One of such additions was made at the Porto Alegre United Nations conference in 2002, focusing on preserving *culture* as an essential value necessity for sustainable development (United-Nations, 2012).

The new commitment in 2012 to the sustainability movement by world leaders is termed, 'the future we want' (United-Nations, 2012), thus affirming their original commitment to sustainable development. There, the leaders acknowledged poverty as the greatest problem facing humanity, hence their reaffirmed commitment to its eradication. This is in line with the objective of this thesis, which is aimed at fighting poverty in the developing world (focusing on Ghana) through the use and development of technology manufactured sustainably for local industries.

Talking about poverty, the world's poorest nations are concentrated in Sub-Saharan Africa (CIA-WorldFactbook, 2013). The world leaders' intention of eradicating poverty brings the question of; how? By what approach do they intend to tackle the poverty menace, despite, for example the case of Ghana, previous national global efforts which have failed to yield a response in growth (see Chapter Two of this thesis). This study could not find a definite approach, methodology or framework

outlined by the world leaders to address this issue apart from agreeing in principles to commit to such course. And at the national level (in Ghana), the industrial policy framework enacted (The-Republic-of-Ghana, 2011) did not emphasise on manufacturing of technology and its sustainability approach, but instead, it wants to 'ensure the adoption of modern technology and the deployment of state-of-the-art plant and machinery in industry' (ibid). The picture is a vicious cycle, where, when these technologies (often imported), go obsolete, as is always the case, then the nation starts all over again to seek the next generation state-of-the-art technology. Such conventional method in the policy does not seem to hold much promise for sustainable development initiative approach in Ghana and Africa at large.

It may therefore be said that both the developed and developing countries may agree on the principle of sustainability, but the ability to adequately implement the details could be problematic (Short et al., 2012b), especially for the developing world. For example, while the industrialised countries can comfortably focus more on securing the future by developing new and more efficient technologies, developing countries on the other hand are still grappling with the very basic demands of daily life (Short, 2008) and as such, may see the need for their initiative to *sustainability* as a burden, thus endangering the future of the concept.

4.4.1 Approaches to Sustainability

As human needs have now been integrated into the environmental concerns for sustainability, the concept is now rapidly becoming all-encompassing, incorporating items

(concerns) not previously captured like economic implications and social factors (Herrmann, 2004, Sutcliffe et al., 2009) as earlier mentioned. For example, the concept took on a wider scope leading to the development of what is often referred to as the 'Three Pillars of Sustainability' by the Corporate World of business and accountants (Sutcliffe et al., 2009). This approach, in addition to environmental concerns looked at the social impact of their business activities as well as economic issues, thus; taking a social corporate responsibility (CSR) for their actions as tangible contribution to a firm grounding of *sustainability* (ibid). This three-pillar approach, called the *triple bottom line approach*, is represented by three rings overlapping each other as shown Figure 7 below. Edgerton (2008) and Sutcliffe et al. (2009) demonstrated how the businesses circle would seek to use less resources in their operations and reduce their impact on the environment, making a difference by not focusing solely on profit making. How this could be applicable in a developing country context remains yet to be seen. Most Ghanaian owned business are small to medium enterprise (SMEs) businesses (Tybout, 2000, Teal, 1998, Frazer, 2005) and research suggests that such businesses [in the manufacturing industry], even in the industrialised world, are less likely to implement sustainability methodologies (Short et al., 2012b) as compared to their larger counterparts. The big businesses which are seen as having the capability to take on and apply the concept are mostly multinational corporations (MNs) who may not be under any obligation to do so, but may comply only as they wish.

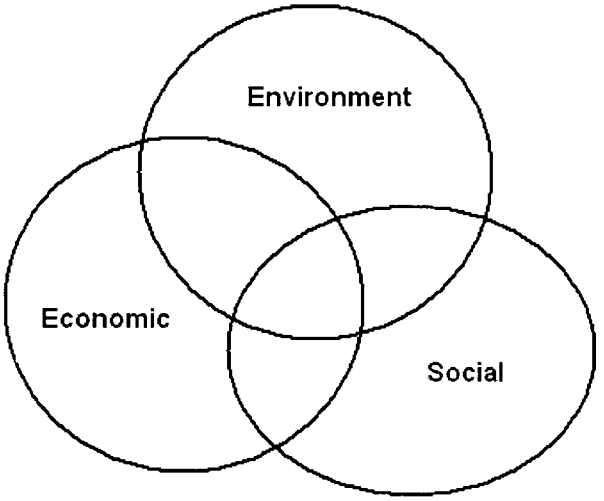


Figure 7: Triple Bottom Line (Sutcliffe et al., 2009)

Expanding further on the definition of the concept, a similar principle as the CSR is applied by the Royal Academy of Engineering, focusing on engineering concerns in terms of how engineers could wholly adopt the sustainability principles in their technical work procedures including their commercial attachments. There, the Academy (based on the 2005 UK strategy on the principles of sustainable development) presented sustainability as 'the process of moving human activities to a pattern that can be sustained in perpetuity'. The Academy came up with a model shown in Figure 8 below, which defined sustainability as consisting of the 'Eco-centric concerns; socio-centric concerns and the techno-centric concerns' (Dodds and Venables, 2005). When these three components are brought together to overlap as in the case of the CSR, (i.e. when these activities are carried out) in effect, sustainability is achieved or allocated in the centre of the three overlapping circles (see Figure 8). Sustainability is here seen as 'the principle of intergenerational equity' (ibid).

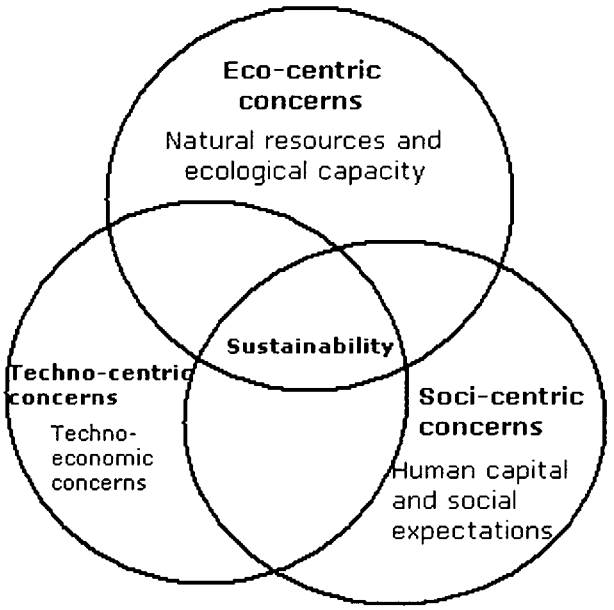


Figure 8: Three dimensions of sustainability (Dodds and Venables, 2005)

According to the Academy, the;

> *Techno-centric concerns', which encompass techno-economic systems, represent human skills and ingenuity – the skills that engineers must continue to deploy – and the economic system within which we deploy them. 'Eco-centric concerns' represent the ability of the planet to sustain us – both by providing material and energy resources and by accommodating us and our emissions and wastes. 'Socio-centric concerns' represent human expectations and aspirations – the needs of human beings to live worthwhile lives, summed up by the phrase in the UK Government's interpretation of sustainable development as 'a better quality of life for everyone, now and in the future'* (Dodds and Venables, 2005)-(pg.7).

The academy explained that when these three aspects (circles) eventually fuse together into a single ring, than sustainability is fully achieved and engineers have the obligation as key players towards this achievement. The social and economic context within which such fusion is anticipated has been conceived within a definition of the UK planning system.

With the highly acquired level of development balanced with long lasting political and economic institutions that have been tested and proven over centuries, UK, from historic indications, stands a better position that is way ahead (Acemoglu and Robinson, 2012, Tabellini, 2010) of any such description that could be accorded a [relatively] young and developing economy like Ghana.

The setting in both countries are very different as Ghana is yet to develop its internal organisms and structures (Price, 1975) to attain an appreciable level of engineering activity such as in manufacturing. Also, its social and economic conditions, from historical background, leave the country with little technological growth (Teal, 1998). As such, how the UK model of sustainability could be applied would require large consideration on the developing country scenario, where, for example, the techno-centric concerns may not be defined for Ghana in the same way as in the UK. That is to say, in the UK, the skills required by the engineer could be specialised since supporting infrastructure and amenities like road networks, water supply, availability of electricity, transport system, etc., could be comparatively better relied upon (Jarvis, 2005). But in Ghana, it would be advantageous for the engineer to possess a multiplicity of skills and be able to improvise very quickly. In such a case, the Ghanaian engineer would be concerned mainly with, say, making

the engine to run, irrespective of how much fuel is burnt within a short space of time. Similar scenario is described by Edgerton (2008) where the Ghanaian automobile repairer (referred to as Fitter) carries along extra vehicle spare parts and is able to make repairs to the engine using crude materials like nails as lock pins, etc. The model could be described as a good starting point for consideration where issues of technology development (creation, usage and deployment) would be carried out not only with the thought of its functioning, but its economic and social implications: however, successful application to the status quo in a developing country is doubtful.

Indeed, the application of sustainability is subjective, based on the timing and prevailing circumstances.

On the basis of the explanation given by the Royal Academy of Engineering, the work of Sutchcliffe, et al, (2009), posits that the three pillars could be represented in a different way. This new three-pillar approach is known as the *deep green theory*.

The theory holds that, because of the finite level of natural resources available to the human population, the primary priority is always to find ways to live within the natural constraints of the ecosystem (Sadler, 1999). Three concentric circles are also used to represent the Deep Green Approach as shown in Figure 9 below.

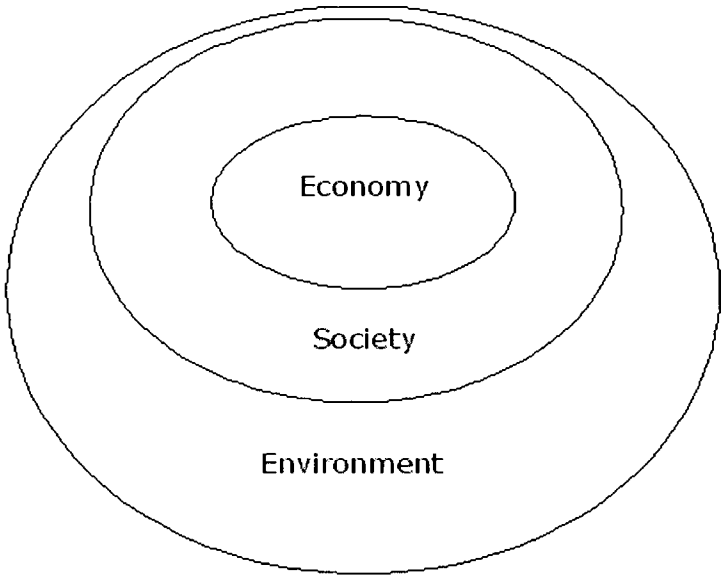


Figure 9: Deep Green approach to the three pillars of sustainability (Sadler, 1999)

As can be seen from Figure 9 above, the inner circle represents economy, the middle, society, and the outermost for the environment. This tends to convey the impression that the economy is embedded in society, while society and economy should both be viewed in the wider environmental context, thus, embedded in the environment. This suggests a stress on environmental consideration in all social and economic processes to meeting human physical needs.

The general discourse on *sustainable development* has been expanded beyond the three-pillar approach to incorporate the cultural consideration, as earlier mentioned, for its vitality, thus, making it the Fourth pillar of sustainability. Advocates here argue that culture has to be a separate and "distinct" reference point, not embedded in any of the popular three pillars. As such the pillars of sustainability should be considered as four, with the fourth being culture (Hawkes, 2001).

The four-pillar model incorporates four interlinked dimensions (see Figure 10 below), which are: environmental responsibility, economic health, social equity, and cultural vitality (CECC-Cultural-Research-Salon-SFU, 2006).

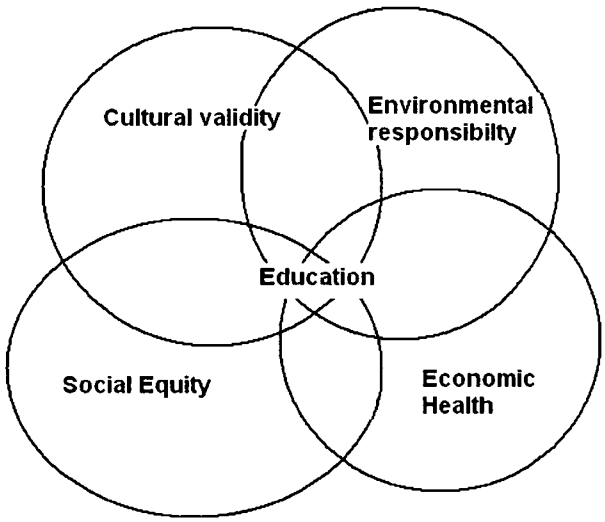


Figure 10: The fourth pillar of sustainability included (CECC-Cultural-Research-Salon-SFU, 2006)

The area of culture is relatively new and narrowly defined. In Culture, as the fourth pillar, Keith Nurse points out from Raymond Williams' (1983) book entitled "Culture", that there are at least four contested definitions of culture (Nurse, 2006). These are:

1. A developed state of mind – as in 'a person of culture', 'a cultured person';

2. The processes of development – as in 'cultural interests', 'cultural activities';

3. The means of these processes – culture as 'the arts' and 'humane intellectual works'; and finally,

4. Culture, as 'a whole way of life', 'a signifying system' through which a social order is communicated, reproduced, experienced and explored.

Culture, therefore is argued to assume a vital position when building consideration (tradeoffs), planning or assessment for sustainability. The common aspect to this dimension is the centrality of education, which is seen as vital in bringing these aspects together to function. However, talking on education, Szogs, et al. (2009) argue that;

> ... [educational] *efforts by developing countries are skewed towards rigid curriculum that are not in tune with modern business demands and entrepreneurial opportunities and away from knowledge* (pg. 8).

The rigidity exhibited by the educational setup in developing countries, means that they lack the flexibility to introduce new and relevant knowledge as they are not dynamic to changes. Even when educational reforms are implemented, after the initial thrust of excitement, the features expected of the reform soon disappear (World-Data-on-Education, 2010/11). The educational concern could be developed further in a separate study elsewhere.

In addition to the four-pillar dimension is the seven pillar-approach, which looks at ecosystem management (Lackey, 1998). Also is the seven-question approach developed for assessing sustainability implementation (MMSD-NA, 2002). This serves as a guide to ensuring no important aspects for consideration in an implementation project is left out (Jovane et

al., 2008, Organisation-for-Economic-Co-operation-and-Development, 2009).

The seven-question pillar model (MMSD-NA, 2002) focused on project implementation, in effect, centres on:

1. Engagement; to ensure there is a commitment to engage the affected community in the process implemented.

2. People; asking the question, if the project will improve the well-being of the people.

3. Environment; how the biophysical systems can continue to provide support for other life forms.

4. Economy; concerns the long term viability of the local, region, and even global economy for sufficiency.

5. Traditional and non-market activities; this is focused mainly on ensuring the project contributes to the long-term viability of traditional and non-market activities of the community of implementation.

6. Institutional arrangements and governance; this component asks whether there is institutional arrangement and systems of governance in place to adequately regulate, promote and protect communities, etc., of any consequence from the project.

7. Overall integrated assessment and continuous learning; seeks to establish if an overall evaluation, backed by subsequent re-evaluation possibly for alternative configuration.

These seven questions, when addressed to providing ideal responses set, from the sustainability approach perspective, the scenario for avoidance of potential future hazards.

As argued earlier, manufacturing, according to this thesis, forms the centre-piece of all human livelihood and dependency, as such; sustainable manufacturing forms a core concern requiring all stakeholders' involvement, such as industries, governments and consumers, in addition to the operations of the market. The major interest here is how these approaches could be truly implemented in the Ghanaian scenario, where technology manufacturing is yet to begin. Currently, technologies available in the country, like most developing countries, are imported; as such, any assessment would be based on the product designer's intent from the home country of the technological piece. That is to say, at the moment, Ghana may have extremely little or no influence on a great number of technologies until it is able to set up, run and maintain its own manufacturing base.

4.4.2 The Sustainability Approach in a Developing Context

To curtail the likelihood of any future man-made environmental or societal disaster (World-Commission-on-Environment-and-Development, 1987), there is the need for a nation like Ghana aspiring to industrialise (Ministry-of-Environment-Science-and-Technonology, 2010, The-Republic-of-Ghana, 2011, Republic-of-Ghana, 2011a) to seriously take on board the full principles of *sustainability*. Application of the concept has become so widespread, though subjective, that it is used as a tool to gain marketing advantage (O'Brien, 1992). Any technology

development policy approach to be developed for Ghana without the full consideration of the concept may not enjoy the success it would have deserved, beside endangering future generations from being able to meet their needs.

This study, not being on *sustainability* concept, will not expound further on the subject here, but will leave it to a future study elsewhere. The concept however, is suggested here, as part of its future development, should not be limited to the above mentioned initial principles alone. Taking inkling from the global transition and widespread economic decline, one cannot but take to serious account the possible factors that might have led to, or contributed to the downturn. Such factors, as perceived within the scope of this study, which includes excess consumerism and materialism characterising the modern world could be described as one of the many stimuli that spurred manufacturing on the current global scale; hence, the need for the consideration of sustainable consumerism (Young et al., 2010).

This level of consumerism should serve as a warning to protect the future generation from retrogressing on human civilisation. Human wants are insatiable, as such; this concept should entail provision for self-control on the part of individuals to appropriate just enough of what they need. There should also be some of form of control on market and advertisement so consumers are not swayed by product glamour and appearances, but should embrace such activities as product maintenance, which may include such practices as repairs, manufacturing with reconditioned components, parts reuse, etc. In fact, the barter system of trade mentioned in sub-Subsection 3.3.2 of this thesis should be considered for extensive application, as part of a

future study for the business model. This is to reduce the burden involved in the large cost of printing money as cash. Appropriate accounting system will therefore need to be devised to account for trading and documentation in relation to the barter trading mentioned. The works of Edgerton (2008), Sachs (1992), Schot, et al., (1997) and others advocate a consideration in opting for technology development. These may provide a truly sustainable future; an approach that could be referred to as, "consumer self-control purchasing pattern" despite the glamour of advertisement. This is based on the argument that if there is no market for a product, there will be no incentive to manufacture it.

As the sustainability concept now assumes several names such as: environmentally friendly production, green production, green manufacture, going green, the green movement, etc., it may be suggested here to consider a name that portrays customer (user) self-control purchase production. This may tentatively be referred to as consumer self-control.

4.4.3 The Challenge to Achieving Sustainable Manufacturing Practice

On how sustainability practice is assessed, there seems to be considerable progress at efforts to reach an acceptable assessment methodology (Kaebernick et al., 2003b) for sustainable manufacturing, but further work is required in this area. The main challenges as to how the methodologies could be applied in a developing country context still hang unaddressed. In Ghana, for example, the starting point might be to consider how government could approach, from its development agenda, a national technology development scheme, with elaborate

guidelines linking the formal sector of governance to the traditional (customary traditions and culture) and informal sectors of the country. This being that, currently, government is almost the sole driver of such major projects in the country since the private sector is not developed (Price, 1975) and costmary systems marginalised (Kleist, 2011).

The work of Schot (1992) demonstrates that governments' efforts at developing technologies are often faced with difficulty at surviving in the market. Combining this with the characteristic failure of State corporations in Ghana (Price, 1975, Teal, 1998), a national system of manufacturing technology would have to be thoroughly scrutinised in its methodology, so as to set it on a successful future path. Schot believes the role of government, which may include infrastructure, competitiveness, nature of mixed background of expertise involved in a development consortium, etc., would need to be set for a specific technology development. Whether this suggestion may work equally the same way for Ghana is yet to be proven. However, it could be initiated by putting in place the right regulations as in prescribing standards and charging levy in a manner to stimulate and drive the sustainability vehicle in the desired direction of growth, encouraging the private sector [including traditional leaderships], with cultural considerations, to lead the way, though with necessary caution to avoid exploitation and excessive wielding of power (Arhin, 1990).

In this case, educating the local Chiefs and Community Leaders to encourage their subjects on lines of entrepreneurial pathways, imbued with the spirit of always seeking to improve whatever they do or have around them, including tools and equipment

used in daily tasks. That is to say, this consideration should be projected towards the involvement of traditional leaders to stimulate the spirit of entrepreneurship among their subjects as a national policy agenda. This way, it is hoped that the whole approach to sustainable development will be engrafted into the very fabric of the society, hence, its total absorption in the Ghanaian system. This will help it not be seen as one of those 'post-colonial' package served on the people by the ruling class who are often seen as stooges ruling in the seats of their former colonial masters (Agyeman-Duah, 1987, Akyeampong, 2001, Herbst, 1997).

Summarising; *sustainable development* has been viewed under the umbrella of its approaches to definition and implementation and this was looked at with Ghana as the developing country in the backdrop. The practice of the concept is faced with challenges of practicability even from the industrialised countries, which are expected to spearhead adherence to its principles. Scholars have shown how, in reality, most companies do not practice ecodesign at all (Short et al., 2012a). Surprisingly, the importance of the implementation of sustainability principles have not yet been fully grasped by industry and those responsible to lead the way (ibid) even in industrialised countries. Also, the extent of its application to building a national system of technology in a developing country, however, remains very limited and highly unexplored. This implies much challenge lies ahead. It is hoped that this study will contribute to increased understanding of how developing countries could move towards a more sustainable development agenda in their efforts to build a technological base.

4.5 Chapter Summary

In summary, this chapter took the discussion of *manufacturing of technology* as its theme looking at how other fields of study, from the expanding theories of economics to historical perspectives and sociological analysis, understudied technology. It was found that technology change brought remarkable changes to the course of their theories and fundamental principles. When these fields of study were compared to the field of engineering, engineering responsible for creating the technologies (manufacturing engineering), it was found within the scope of study of this thesis that there was no provision for technology discussions in manufacturing engineering. New development in principles, philosophies, or theories in manufacturing engineering were sought mainly in the line of approaches, guidelines or frameworks for technology development in developing economies, but none was found. However, technology development was seen to have brought changes to theories in other fields of study. A proposed concept of *development engineering* was therefore considered as a possible approach to initiating a discussion from the engineering perspective. This concept is aimed at establishing development technology principles as a multidisciplinary approach and an off-shoot of manufacturing engineering with focus on how a developing society could manufacture and further develop its technology base for its socio-techno-economic development.

Seeking an approach for technology development led this chapter to consider the model of technology development from selected countries like the USA, Germany and Japan. It was found that these countries and others obtained their initial

technology from England and built an innovative approach to developing their technology base.

This technology development approach for the developing world, with Ghana as the focus, will have to be done in a sustainable manner so as not to endanger the survival of the future generation.

Finally, the issue of the *sustainability concept* was discussed as a paramount factor to any manufacturing process to be initiated. Building *sustainability* into the development agenda, it is hoped, will reduce, and if possible, eliminate the perception of the concept as being a burden on the manufacturing institution.

CHAPTER FIVE

5.0 RESEARCH STRATEGY TOWARDS A CHOICE OF METHODOLOGICAL APPROACH

5.1 Introduction

The subject of seeking a means for technology manufacturing in the context of a developing society like Ghana is deemed highly complicated owing to the historic pattern of repeated failures of previous attempts towards industrialising the economy. The approach, in terms of which research methodology will be most suitable for this study, becomes the challenge. Though this study is situate in engineering, the understanding of human society required here to build the technology framework could not be approached by modelling mathematical formulae or using statistical manipulations as is common in engineering experimentations and researches. An alternative research methodology needs to be sought here.

This chapter is therefore focused on coming up with *mixed-research methods* (also referred to as multi-methods) approach. This approach is considered as the research strategy deemed to provide an appropriate framework of methodology suitable for the complex nature of this study. The nature of the problem is here considered as ill-structured and such problems, as found amongst the scholarly group of production and operations management, are generally not suitable to be presented in numerical variables (Simon and Newell, 1958). As a result therefore, the concept of soft research approach is employed (Heyer, 2004, Simon and Newell, 1958). This approach is

predominantly found in the social sciences with its variant of mixed research methods developed from it. This chapter therefore examines and explores into the mixed research methodology to apply to this study.

The search for a workable methodological approach for this thesis is therefore viewed as extremely vital; something that could possibly impact on the success or failure of the project. Hence, the search for a methodology for this thesis, which could be a unique methodology, takes a number of factors into consideration, some of which include:

- The historical background to establishing an industrial base in Ghana.
- The multicultural and complexity of the Ghanaian (African)society
- The confusion in research approaches and methodologies owing to inconsistencies on the part of researchers in the use and definition of research terminologies.
- The view of proponents and critics on innovations in research methodologies.

The historical background to the theme of this research, as discussed in the previous Chapters Two and Three of this research report, requires careful judgement in the scrutiny of scholarly research theories towards taking a decision on a methodological approach.

The aim here therefore is to distinguish between such research terms as; research paradigms, methodology, method, philosophy, qualitative and quantitative research (Bryman, 2012, Glogowska,

2011, Mackenzie and Knipe, 2006). This is to include the mode of methodology combination and paradigm mix in the emerging approach of mixed-research and paradigmatic research philosophies found in the social sciences (Greene, 2008, Johnson et al., 2007, Mackenzie and Knipe, 2006). It is hoped that the differentiation will provide a level of clarity from the indiscriminate use of the terms by research scholars. The means to clearing the confusion here would be to streamline the definitions, where applicable, to a common understanding in this thesis and adopting a more consistent usage of the terms to specific applications so as to reduce the current ambiguity in their usage. See Appendix Two for detailed discussion of the methodology for this thesis for lack of space limits.

5.2 Research Strategy: Combination of Methodologies

This study, being an inductive research seeking to contribute a solution to the perennial difficulty faced by Ghana and African countries in developing their technological base, (see Chapter Two) will require a strategy in research that provides the tools and flexibility needed to understand the research problem so as to suggest possible solutions. As noted by some authors, the conflict of research paradigms and combination of methodologies has finally been settled (Glogowska, 2011) with the philosophy of pragmatism gaining much prominence in social science research for its pragmatic practical approach to addressing research question (ibid). This therefore defines the *mixed-research* strategy as a distinct research strategy on its own. According to Brannen (2005), in an attempt to address a

research question or set questions, the researcher must devise a strategy.

The pragmatic methodology combination (i.e. mixed-research strategy) deemed most suitable for this research is the mix of such methodologies as; *ethnography*, *grounded theory*, and *case study*. It might be helpful to consider each of the methodologies separately to establish the relationship for the strategic combination.

It may be summed up from the discussion so far that the choice of methodology combination would be determined by the nature of research question defining the problem at hand. For the purposes of this thesis, it is suggested that the most appropriate combination is (considered to be) *ethnography*, *grounded theory* and *case study* methodologies. These methodologies, it may be argued, constitute paradigms of the same research framework as can be deduced from the work of Mackenzie and Knipe (2006). Such argument could be true, but paradigmatic dimensions do not define individual methodologies, as understood from the work of scholars previously cited, neither are methodologies restricted to specific paradigm domain as demonstrated by developments in research practice (see section 5.2 above). And in fact, the three methodologies differ in actual practice and intensity as will be shown later in this discussion. Under certain circumstances, for instance, some critics argue that these methodologies are all fundamentally ethnographic. This researcher therefore takes the time to explore the worldview of scholars to highlight the distinction between ethnography, grounded theory and case study as theoretical frameworks to

ground their defining task and suitability as *mixed- research methodology* for this thesis.

5.2.1 Ethnography

The practice of ethnography, being a qualitative research methodology, involves fieldwork in which the ethnographer lives among the population being studied ((Bryman, 2012), Chapter 19). While trying to retain objectivity, the ethnographer lives an ordinary life among the people, working with informants who are particularly knowledgeable or well placed to collect information. This fieldwork may last for extended periods of time; usually over a year, and sometimes much longer depending on circumstances (ibid). The circumstantiality are influenced by the place in its dimensions and the communication that may flow between the ethnographer on one side and his/her informants on the other side (Appadurai, 1988).

Ethnography, traditionally found in Cultural Anthropology, both as a research methodology and product of research (Marcus and Cushman, 1982) is confronted with the difficulty of definition by scholars as various disciplines identify with it in diverse ways for their specific objective (Atkinson and Hammersley, 1994). Using identical indications from the available literature, ethnography could be summarised as a research in a natural setting, with intimate face to face interaction with participants to accurately reflect the participants' perspectives and behaviours (Schensul, 2005). Ongoing dialogue in the subject shows that such definition is oversimplified and lacks the scrutiny of emerging challenges in genre and traditional procedures (Thomas, 1991).

The progressing discourse of practice and genre in ethnography, considering its realist, postmodern and deconstructivist debate (Marcus and Cushman, 1982, Sangren, 1988) argues against the traditional branding of fieldwork (Clifford, 1988) as its major standing feature to be observed, thus ethnography and fieldwork are separable (Thomas, 1991). These contentions and polemic positions by scholars present the methodology with a feature of fluidity and plasticity which may enable a wider spread of application beyond its traditional confines, thus in addressing problems most suited (Wolcott, 1990).

According to Atkinson and Hammersley (1994) the span of the confusion stretches between two extreme points; those who view ethnography as a philosophical paradigm to which one makes a total commitment, for others it designates a method that one uses as and when appropriate.

In Marcus and Cushman's work (1982), traditional presentation of ethnography is fundamentally being reshaped by the growing trend of epistemological concerns of the process of how interpretations are constructed and how they are contextually presented. Contemporary ethnography is making a methodological attempt to create a science of interpretation (ibid) thus exploring epistemological issues as an integral, vital part of cultural analysis.

Due to the broad scope of how ethnography is interpreted, time and space may fail this study in the attempt to arrive at what may be acceptable as the standard representation. As such, its tenets and description to which this study may want to conform to, may view ethnography as a research methodology situated within the expanding arguments of its practitioners. This is

because it has expanded beyond its traditional domain of Cultural Anthropology (Sangren, 1988) and has gained a much wider scope of application among researchers leading to a distinct branch of ethnographic experimentation (Marcus and Cushman, 1982). Thus, as noted by scholars, ethnography is 'itself contributing to the confusion as to "what to call *ethnography*"' (Wolcott, 1990). According to the author;

> *Anyone who engages in ethnography also assumes the responsibility to participate in the continuing dialogue to define and redefine it both as process and as product* (Wolcott, 1990)-(pg. 47).

However, redefining ethnography according to the researcher's intent does not suggest deviating from its traditional core principles of 'making sense of human social behaviour in terms of cultural patterning' (ibid), but,

> *...to engage simultaneously in an ongoing intellectual dialogue about what culture is in general while attempting to portray specific aspects of the culture of some human group in particular* (Wolcott, 1990)-(pg. 48).

Culture, therefore seems to hold a central position in ethnography on which to classify a fieldwork exercise as ethnographic. But the question of what exactly culture is becomes an issue of debate requiring a consensus.

According to Wolcott's perspective,

> *Culture is an abstraction based on the ethnographer's observations of actual behaviours, coupled with insights*

> *and explanations of the order.* [This] *is the assignment for ethnographers to define for themselves* (Wolcott, 1990)-(pg. 50).

Though it may appear that the presence of 'culture' is subjective, as it is assigned to ethnographers to define, it is understood that there is no ethnography until culture makes an entry, no matter how tenuously. By this therefore, the subjectivity of culture is limited by its interpretation (ibid).

This position by the author points to the suggestion that ethnography is not set exclusively as the reserve of anthropological definition and bounds, but holds the flexibility of adoption and application by varying fields of study as may be considered appropriate. Within the limits of change however, the traditional practice of fieldwork remains a distinctive characteristic of an ethnographic work (Clifford, 1988) in relation to culture (Wolcott, 1990). Thus, the Anthropology Professor Emeritus, Harry F. Wolcott points out that undertaking an ethnographic fieldwork should not necessarily attend to everything, explaining that traditional ethnography is too culture-and-context oriented, too holistic, and too time consuming for most purposes' (Wolcott, 1990). It is therefore here understood to imply that, though the research may not be a typical traditional anthropological ethnography studying every aspect of a culture, yet it is ethnography so long as it is fieldwork based with some element of cultural perspective. By this argument therefore, one may assume that any research methodology involving fieldwork could be regarded as being ethnography. However, that argument is faulted and does not

hold if the supposed fieldwork is not concerned with an aspect of *cultural* connotation.

In line with the expanding feature of ethnography, this study may describe it as 'dynamism of redefined ethnography' to solve new problems in the expanding field of research. The word *dynamism* is used to show how ethnography is seen as challenging its traditional hermeneutics, genre and fieldwork characteristics (Marcus and Cushman, 1982, Sangren, 1988). According to Wolcott (1990);

> *Not every setting in which ethnographers might have something to contribute deserves such painstaking effort at cultural interpretation. There is a time and place for everything: ethnographers do not have to be holistic, cross-cultural and comparative, nor meet ordinary expectations of the year or two in the field, every time they set out to explore a problem or are asked a question* (Wolcott, 1990)-(pg. 53).

This gives ethnography much flexibility in its procedure. Thus, a study under restricted timeframe due to limited academic time schedule may engage in what Wolcott (1990) referred to as 'micro-ethnography'. In fact, while standard ethnographies are still being produced continually, as noted by Marcus and Cushman (1982), considerable rewards are offered, both in degree of publisher interest and positive critical response, to ethnographers who couch their work in more personal and novel structured ways (ibid).

These are understood to imply that ethnography allows the ethnographer to represent his or her work as firsthand

knowledge from the fieldwork. But this fieldwork should be from understudying a culture or an aspect of a culture of interest and encouraging novelty in the process and reporting. This is probably mainly because the evidence gathered is relayed by the ethnographer, filtering through his/her own experience, in an attempt to reflect, as accurately as possible, the "true" viewpoint of the people (their culture). What may be considered here as "true" is contextual and debated by scholars arguing that culture is as defined by the ethnographer (Sangren, 1988), hence, subjective. More so, as the "true view point of the people" is actually the researcher's version of interpretation (Sangren, 1988, Thomas, 1991, Wolcott, 1990), therefore, to ascertain the validity of the ethnographic work as not representing the subjective interpretation of the researcher, the process may require the application of a rigorous analysis and reporting system with laid out procedure to eliminate or at least, reduce the subjectivity of the research on cultural study from fieldwork. That is to say, a robust reporting is required. Searching for such reporting system with laid out in the procedure was found in *grounded theory* methodology, which will be discussed below.

5.2.2 Grounded Theory

One major difficulty in qualitative research, as compared to quantitative research of figures and numerals, is the task of how to analyse the corpus of textual data generated from fieldwork or literature. Grounded theory, which could be seen more as an analytical technique than a method provides the technique whereby a narrative or theory is generated from data (Gibbs, 2008). Grounded theory, as a methodology, is unique in the sense that in contrast to other methodologies where the purpose

is either to test a hypothesis or answer a research question at the start of a research process (Roberts, 2008), grounded theory generates the hypothesis as data are collected (Bluff, 2006, Cutcliffe, 2000, Roberts, 2008).

According to Bryman (2012), there is still confusion as to what grounded theory is; to some researchers it is a distinct methodology or approach to qualitative research in its own right, while to others, like Gibbs (2008), it is an approach to generate theory or narrative. Both views seem to hold as different researchers, taking any of the views find it worthwhile doing so (ibid). In any case, data will need to be analysed before a narrative can be generated from it. It is the analytical property of grounded theory that explains its bourgeoning popularity among researchers (ibid) and expanding to wider fields of application beyond sociology into such areas as anthropology, nursing and others (Cutcliffe, 2000). According to the outcome of a survey by Graham Gibbs (Gibbs, 2010), grounded theory forms the largest block of methodology employed by modern researchers taking up to over 50% of methodologies used. This attests to its widespread applicability to addressing research issues.

Roberts (2008) provided a brief historic account of the origin of grounded theory; originally developed by joint work of Glaser, a quantitative researcher and Strauss, a qualitative researcher. This was their only joint publication in 1967 called the *Discovery of Grounded Theory* (Glaser and Strauss, 1967). Since then they have published separately on this topic, with apparent similar conceptual ideologies but different applications (Roberts, 2008). The separation of the authors due to a disagreement in opinions

on the direction the concept should be developed further most likely accounts for the different applications and perspectives derived by researchers adopting either of the two versions (Bryman, 2012). As presented by Roberts (2008), citing the work of Denscombe (2003);

> *...though the originators of this research methodology may have gone in different directions in their development of grounded theory there are still basic concepts which are core components of this approach* (Roberts, 2008)-(pg. 679).

It is the application of the basic concept and any beneficial line of development that is of interest to this sub-subsection, rather than taking sides to follow either of the progenitors of the concept (Bryman, 2012). The original concept as described by Glaser and Strauss allowed both qualitative and quantitative researchers to apply the methodology to their research interest (Roberts, 2008), hence, its applicability by both research approaches, 'however it is most commonly found in [qualitative research] due to the flexibility that is required in research design' (Bluff, 2006). Thus, the details of the procedure of each version will be used to determine which suits a research approach the most. That is, the procedure determines which version to work with. Straussian version seems to provide the kit for this study as it allows for an initial literature review. Glassian's on the other hand advocates for an abstraction requiring no research question or background knowledge (ibid) and this has not been the case in this study.

Grounded theory has specific procedures for data collection and analysis, 'although there is flexibility and latitude within limits' (Corbin and Strauss, 1990). The authors stated that;

> *Each researcher must tread a fine line between satisfying the criteria* [of grounded theory] *and allowing procedural flexibility in the face of the inevitable contingencies of an actual research project. However, to the extent that circumstances permit, following the procedure with care gives a project rigor* (Corbin and Strauss, 1990)-(pg. 6).

The authors went on to provide details of what is to be regarded as the procedure to follow in carrying out a methodology of grounded theory in research. Here, the [theory or narrative] generated is grounded in the data of the research (ibid). Their work also details the evaluative criteria to identify a research of a grounded theory approach. In Corbin and Strauss' (ibid) statement,

> *While grounded theory has not changed in form since it was first introduced in 1967, the specificity of its procedures has been elaborated in some detail as the method has evolved in practice. The procedures are designed to develop a well-integrated set of concepts that provide a thorough theoretical explanation of social phenomena under study* (Corbin and Strauss, 1990)-(pg. 5).

Corbin and Strauss also stated that the use of the methodology should explain as well as describe the phenomenal context of its study. The authors outlined the procedure thus; 'Like other

qualitative research, data collection procedures involve interviews, observations', as well as other documents and literature or 'anything that sheds light on questions under study' (ibid). Collected data are *conceptualised* into theory or narrative, rather than using the actual data in reporting.

In the elaborate procedures drawn out by the authors, concepts generated from the data are grouped into *categories* so that their properties, dimensions and variations could be *sampled* and *analysed* by constantly comparing incidences that could be identified from the dataset. Any *patterns* and *variations* occurring in the data must be noted and the whole process fed into the *theory* or *narrative* as part of the process analysis. Formulation of the theory cannot be done without the writing of *memos*, which should begin with the first coding session and continue to the end of the research, constantly revising the *hypothesis* relating to the categories. These procedures however go with creativity and flexibility (Cutcliffe, 2000).

The types of coding employed, as an analytic process, forms a unique feature in grounded theory. Three stages of coding are listed by Corbin and Strauss (1990) and these are: open coding, axial coding and selective coding.

In open coding, the researcher explores the whole data set, breaking it down to create generative and comparative questions. This is analysed through themes leading to insight for further questions, thus, generating categories and sub categories from the set by grouping similar themes or concepts. The comparative work helps to identify the properties and dimensions in the data set.

In axial coding, the relationship between the categories and sub categories become the subject of interest. The relationships are here tested drawing from a broad range of understanding, including personal experiences if it will help better understand a situation.

Selective coding is where, 'all categories are unified around a core categories' (Corbin and Strauss, 1990) leading to conceptualisation and emergence of narratives as the case may be. Here, reference to the coding becomes of use in selecting which analytical theme that best represents a concept being put forward.

The two fundamental characteristic features that distinguish grounded theory from other research methodologies are: 1) data collection and analysis, which are linked together from the beginning of the research and proceed in parallel and interact continuously (Roberts, 2008) and 2) the data are coded in the process of analysis right from the data collection point (Corbin and Strauss, 1990). Thus unlike other research methodologies, in grounded theory, 'data collection and analysis occur in tandem' (Roberts, 2008). The analysed data determines the questions for the next set of interview (Bryman, 2012, Corbin and Strauss, 1990, Roberts, 2008) leading to the snowball effect (Bryman, 2012).

Grounded theory is considered extremely useful especially in the event where a methodology that will be able to generate a narrative or theory from data is most needed. This is unlike the situation where theories are generated and sometimes 'turn out to fit no data at all' (Borgatti, 2005). Some critics however see this as a drawback, arguing that theory is first required in

research to set the premise for data collection (Gibbs, 2010b). This position by the critics really does not hold, as in Straussian version of grounded theory, background theory and research question/s could be used and the narrative or theory generated will confirm or disagree with it.

Though useful and popular, grounded theory comes under further scrutiny. For example, it is not accorded that same level of appreciation by all researchers. Even from within the developers of the concept, there is strong disagreement as shown by the separation of Glaser and Strauss, earlier mentioned. Glaser accuses Strauss and Corbin of being too prescriptive in the structured manner by which they were developing the concept (Glaser, 1992, Glaser and Holton, 2004). Glaser, in his work with Holton (2004) advocated for a more conceptualised approach to grounded theory. The authors argue that the conceptual nature of classic grounded theory renders it abstract of time, place and people. While it is grounded in data, its conceptual hypotheses do not entail the problems of accuracy that plague qualitative data analysis methods.

Kathy Charmez, from her constructivist perspective criticises the progenitors of the concept (Corbin and Strauss, 1990, Glaser and Strauss, 1967) for being too *realist* in their approach (Charmaz, 2003). She instead argues that the world around us is constructed and it is the construction that grounded theory needs to grapple with (ibid), further stating that;

> *Now grounded theory has come under attack from both within and without. Postmodernists and postructuralists dispute obvious and subtle positivistic premises assumed by grounded theory's major*

proponents and within the logic of the method itself. What grounded theory is and should be is contested (Charmaz, 2003)-(pg. 250).

Still, many more criticise the methodology, some describing it as being difficult; that theoretical sampling takes a lot of time, theory cannot be set aside from the start of research before data collection begins and others argue that outlined procedure for coding the data actually breaks up the narrative flow of data (Gibbs, 2010b). In spite of these criticisms, grounded theory seems to have found its way to situate itself well within the research community and become the most popular among researchers.

As qualitative research is subjective, so is grounded theory. For example, 'what is discovered about "reality" cannot be divorced from the operative perspective of the knower, which enters silently into his or her search for and ultimate conclusions about some event' (Corbin and Strauss, 2008).

Indeed, grounded theory responds to its critics to address vital issues, thus, making it robust. For example, *positivism* was its initial paradigm when Glaser and Strauss launched their only co-authored book on the *Discovery of Grounded theory* (Bernard, 2013). However, contributions made by Kathy (1995, 2000 and 2002), according to Corbin and Strauss (2008) from her *constructivist paradigm* background has influenced grounded theory to shift from an almost totally inductive approach to an inductive/deductive inclusive approach (Bernard, 2013). This method allows the 'respondents and researchers create data together, interactively, during an interview', thus, shifting the philosophical paradigm of the research methodology to 'Symbolic

Interactionism and Pragmatism' (Corbin and Strauss, 2008, pg. 88). Bernard, however, sees this combination as rather belonging to the *interpretivist* tradition of the social science (pg. 525).

It is this new paradigmatic position that makes it possible to draw upon the researchers' personal experience 'to bring up other possibilities and meanings' (ibid, pg. 80). Indeed, according to the progenitors of the concept;

> *When we share a common culture with our research participant, … we, as researchers, often have life experiences that are similar to those of our participants. It makes sense, then, to draw upon those experiences to obtain insight into what our participants are describing. … We are not suggesting that a researcher impose his or her or our experience upon the data. Rather, we want to use our experiences to bring up other possibilities of meaning"* (ibid, pg. 80). *[#] We find it more helpful to acknowledge our biases and experiences and consciously use experience to enhance the analytic process"* (Bernard, 2013)-(pg. 85)

To ensure robustness in the research findings, a four-standard validity tests are provided by Corbin and Strauss (1998) and Yin (2003) as cited by Thai, et al. (2012). These tests include; construct validity, external validity, internal validity and reliability (Thai et al., 2012). Grounded theory is an iterative process that requires a back and forth interaction between researchers and respondents (Corbin and Strauss, 2008). For example, as part of the validity process, Thai and her colleagues had to present their results to their respondents as indicated in their words;

> *When presenting the results to our respondents, we checked if they recognized themselves in the theory. If they did not, we tried applying larger concepts until they could* (Thai et al., 2012)-(pg. 22).

It is this iterative property of grounded theory that gives it its rigour, robustness and validity for reliability of narrative generated.

5.2.3 Case study

Case study as a research methodology has long been used in the social sciences (Grünbaum, 2007, Perren and Ram, 2004). There has also been much confusion among leading researchers and authors on case study as a research methodology, as the term is often used to signify different things (Luck et al., 2006, Ragin and Becker, 1992, Roberts, 2008, Yin, 1993, Zainal, 2007).

Despite the confusion in its definition, a commonality found among scholars is the view of a case study as involving the specific study of complex issues in a single event or multiple of events (cases). For example, according to Zainal;

> *Case study research ...allows the exploration and understanding of complex issues. It can be considered a robust research method when a holistic, in-depth investigation is required* (Zainal, 2007)-(pg. 1).

Here, the author views case study as a method, but on the basis of the argument advanced in this thesis, it has been defined as a methodology (see sub-sections 5.2.2 to 5.2.4). Though the author's usage of the term, alongside other authors would be

retained, the understanding espoused in this thesis as a methodology would be applied.

Zainal goes on to provide an understanding of case study as a method that 'enables a researcher to closely examine the data within a specific context', stating that;

> *Case studies in their true essence explore and investigate contemporary real-life phenomenon through detailed contextual analysis of a limited number of events or conditions and their relationships* (Zainal, 2007)-(pg. 1).

Earlier works showed that 'case studies commonly explore, describe or explain the case of interest and enable holistic and meaningful, context-constituted knowledge and understandings about real life events' (Yin, 2003). That is to say, it is an investigation into 'a contemporary phenomenon within its real-life context; when the boundaries between phenomenon are not clearly evident; and in which multiple sources of evidence are used' (Yin, 2003, Yin, 1984, Yin, 1993). This perspective of a case study falls in consonance with the argument put forward by Gerring from his Political Science perspective (Gerring, 2004), where he contrasts the meaning of case study with non-case study as 'affinities – rather than antagonistic approaches to the empirical world'. There, the author argues that;

> *A "case study" is best defined as an intensive study of a single unit with an aim to generalise across a*

> *larger class of (similar) units* (Gerring, 2004)-(pg. 341).

This definition, however, poses a level of confusion as a number of case studies could be reported in a single inquiry (Woodside and Wilson, 2003) or may form part of a wider study (Zainal, 2007). Though Gerring defines case study as involving the study of a single unit, he however argues that the study illuminates the features of a broader set of units, thus;

> *Case studies are not immaculately conceived; additional units always loom in the background* (Gerring, 2004)-(344).

This, he distinguishes as formal (the unit of intensive study) and informal units (looming background units).

Zainal (2007) describes a multi-case design approach to address the inherent drawback of the single-case approach, which lacks the property to draw a general conclusion for its singularity focus. The multi-case design (Nutt, 1993) works through replication (pattern matching) rather than sampling logic (Zainal, 2007). Thus, case study is not limited to the investigation of a single case only. Pattern matching is understood as a technique linking several pieces of information from the same case to some theoretical proposition to raise the level of confidence in the robustness of the methodology (ibid). The robustness of the research strategy transcends paradigmatic boundaries (Luck et al., 2006, Perren and Ram, 2004), where, according to the authors, a case study is defined by the choice of case rather than the choice of methods.

In carrying out a case study research, however, some of the methods commonly used, are: observation, interviews, discussion, accompanied with characteristic fieldwork. Recall, these are found to be replica methods employed in other qualitative research methodologies like ethnography, grounded theory (discussed above) or phenomenology and others. Also, fieldwork is particular to case study as it is with ethnography. It may therefore raise the controversy as to the need for their combination as the choice of mixed-research methodology as in this particular thesis.

As a matter of interest and for clarity, the works of Zainal (2007), Noor (2008), Wolcott (1990) and others are used in the table below (Table 4) to outline some differences between case study and ethnography as understood from the authors. The differences depict their unique features, which complement each other in their specific roles in the inquiry of this thesis. Thus, though they may employ similar research methods, they are intrinsically developed to accomplish different inquiry objectives.

Table 4: Difference between case study and ethnography

Case Study	Ethnography
Observes data at micro level	Observes data at a macro level
Focuses on single or multiple events	Focuses on cultural perspectives and interpretations
Research question and hypothesis are required to determine fieldwork	Might require prior fieldwork before research question and hypothesis are formulated
Describes real-life situation, e.g. communication in workplace	Describes the specificity or generality of a cultural setting
Focuses on a particular issue (event) of an organisation	Focuses on the whole organisation or society

The use of case study as a research methodology continues to attract a wide range of applications to research for a number of reasons that sums up its advantage. According to Zainal (2007), case study, though a qualitative research methodology (Grünbaum, 2007, Noor, 2008), allows for both qualitative and quantitative analysis of data and the 'examination of data is conducted within the context of its use'. In addition, as earlier stated, it uses multiple sources of evidence to understand complex real-life situations under study due to its rich qualitative data of detailed account.

Despite these listed advantages, case study is however faced with much criticism for its lack of scientific rigour and generalisation (Noor, 2008, Zainal, 2007). According to Zainal, its feature of single case exploration has been described as straining it from producing a generalised conclusion, thus, its final results are questionable and ambiguous looking at the [small] sample size (Grünbaum, 2007).

5.3 Concluding Remarks on Methodology Combination

The three briefly discussed methodologies have a number of things in common. For example, they all could be identified within the same qualitative research approach, though quantitative data could be derived from them as well, especially grounded theory and case study (Roberts, 2008, Yin, 1993, Zainal, 2007). As can be seen from authors in the above discussion, all three methodologies ascribe to the same set of data collection methods, i.e. interview, observation, discussion

and focus group. The question that may arise here is; why combine these methodologies seeing they hold such level of similarities in terms of same methods? What differences do they have that can make them carry out different tasks? To answer these speculative questions, here is provided a summary account of the above discussion to highlight salient differences that makes each research methodology unique to warrant their consideration and combination as research strategy for this study.

In summary, this chapter (a portion of it moved to Appendix One), working out a strategy to carry out the research, attempted to establish a clear understanding of the options in research approaches available. It began by attempting to clarify the confusion in the use of research terminologies. Some terminologies were therefore defined leading to the combination of methodologies as a research strategy. These include ethnography, grounded theory and case study.

Though these methodologies were found to have some features in common, ethnography could be said to differ from both grounded theory and case study merely by its name, which portrays a methodology whereby the researcher spends some time living with the community (Appadurai, 1988, Schensul, 2005). Though grounded theory and case study also require fieldwork, their fieldwork is not defined by the intimacy required in seeking 'cultural interpretations' to research phenomena (Wolcott, 1990), having to partake in respondents' experiences (Schensul, 2005). Hence, they differ.

Grounded theory, as earlier shown, provides the technique for systematic analysis of data as they are being collected and

developing a theory or narrative thereby (Corbin and Strauss, 1990, Cutcliffe, 2000, Glaser and Strauss, 1967, Roberts, 2008). This feature is not found in traditional ethnography or in case study approach to data collection. Though grounded theory may focus on studying a particular phenomenon, it may not be most suitable to apply in all such cases, especially where the phenomena are not defined with clear boundaries as shown in case study (Zainal, 2007).

Case study methodology, as its unique feature, provides the means to isolate a particular case (or cases as the case may be) for intensive study and analysis (Luck et al., 2006, Yin, 2003, Zainal, 2007).

The methodology combination in this research strategy is argued to be the most suitable for this study to carry out its aim and objectives to answer the research question

5.4 Data Collection and Analysis Procedure

The overall steps involved in this research's data collection are as follows:

1. Theoretical sampling was employed to determine what type of information was required as suitable the dataset to answer the research question of the study and where to collect such data. The instruments and skills necessary for this task need to be identified.

   For the purpose of this research, it was found that data was required from a broad range of social setting in Ghana; this included technologically deprived society (i.e. traditional

Ghana) and modernised sector of the Ghanaian society (i.e. modern Ghana).

Ethnography was therefore considered as the most appropriate methodology to employ in this case for data collation.

2. Ethnography was used for data collection in both rural and urban settings in Ghana (see Section 6.2 of this thesis). The methods employed here were observation, participant observation, discussion, semi-structured interviews and photographs in the rural areas and structured interview was used in the urban visitations meeting with the Government Officials and other professional groups. A digital voice recording device was used to record the interviews.

   Notes were also taken during the observation period. Similarly, notes were taken during the interview sessions.

   The interviews were transcribed and compiled into a mini-report including the narratives from the observations made (see Appendix Three).

3. The transcribed interviews were imported into Nnvivo (see Figure 11) for analysis using techniques from the Straussian version of grounded theory. Nnvivo is a social science qualitative data analysis software that allows qualitative data to be coded and queried for analysis.

Below is a brief description of the processes involved in the data collection and analysis procedure.

Theoretical sampling in grounded theory allows the researcher to identify areas where data could be collected in regards to the

subject of research mater. In this research, on seeking a framework for technology development in Ghana, it became necessary to attempt to draw the technology trajectory of the Ghanaian society from its very rudimentary level to current modernisation state of development in the nation. That is, to say, seeking data from both traditional Ghana and modern Ghana.

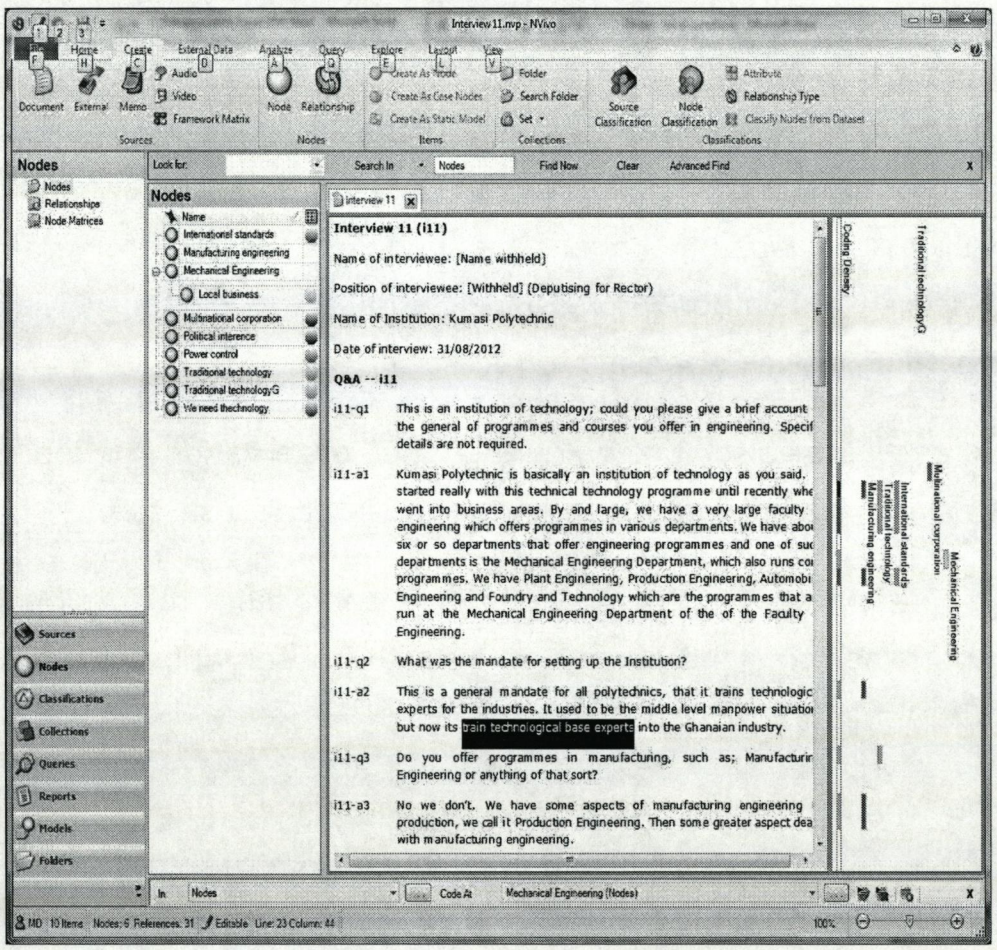


Figure 11: Sample representation of data analysis using Nnvivo

Data from traditional Ghana meant seeking a Ghanaian settlement which may still be practising the traditional indigenous livelihoods and methods of production. The search for such a community was assisted by consulting the vast knowledge of a local Pastor, who knew the surrounding rural

localities where the most technologically deprived of modern amenities could be found. The help of the local Pastor led to two different communities. The first Community was however found not to be sufficiently technology deprived, but the second Community was found to be suitable for this study.

The mode of data collection here was ethnographic in nature. Methods used to elicit data included observation of respondent at work on a particular production, e.g., she butter production, conversations to understand their processes and extract historic narratives from oral tradition, semi-structured interviews and photographing. Fieldnotes were also made during discussions and interviews. These were later transcribed into Nnvivo for analysis.

In the urban areas, here referred to as modern Ghana, Government Officials, Policy Makers, Heads of Institutions and Business Owners were interviewed using both structured and semi-structured interviews. The electronic voice recording device used allowed the interviewee's opinions to be fully captured and transcribed. Details of the transcribed interviews are provided in Appendix Three of this thesis.

The transcribed data fed into Nnvivo analysed by the three coding steps in grounded theory. The software allowed for thematic coding used for the first stage of the process, that is, open coding (see Section 5.2.2 under grounded theory). Here, the codes were grouped into categorised and sub-categories. Their properties and dimensions were identified and the relationship between the categories and the sub-categories were observed, leading to the second coding stage, which is the axial coding. Based on the observed relationships between the

categories and sub-categories, the themes were then sorted around core categories. This is the selective coding stage. The sorting of the themes into core categories was, however, done manually by printing the coded themes, cutting them out and manually sorting them individually into core categories. The Nnvivo software could not perform this for the researcher.

It was at this selective stage of categorisation that narratives were constructed based on the patterns that emerged from the data analysis (see Section 6.3 of this thesis for the presentation of the narratives).

The case study, as enumerated in Section 6.4, was the careful investigation of the shea industry in Ghana to gain a deeper understanding into the Ghanaian attitude towards technology creation. The methods used for data collection in the case study was carried out in tandem with the ethnography in addition to reviewing of relevant literature. In the ethnography, observation of the traditional methods of shea butter production process was made (see Section 6.4.1).

5.5 Ethnography in Ghana

This Section provides a brief narrative of the fieldwork experience in Ghana. The fieldwork is describable as micro-ethnography, due to time constrain (Wolcott, 1990), and it elicited data from a societal setting with little or no exposure to modern technologies. This was with the aim to understand, from the perspective of the society, their cultural interpretation of the prevalence, deployment and manufacture of the technology/ies they use and make (manufacture) themselves in their locality, i.e. manufacturing of their own technologies. In other words, the

aim was to understand how they made (manufacture) the things they need for their survival in their seemingly isolated abode. It was also to identify the factors that might have contributed to shaping their society (MacKenzie and Wajcman, 1985, MacKenzie and Wajcman, 1999, Williams and Edge, 1996, Winner, 1980) to its current form of being secluded from the rest of the world hence, lacking modern technologies.

The fieldwork in this research comprised of three different phases, all undertaken in both rural and urban Ghana. The activities in each phase are as follows:

Phase 1: This phase provided a preliminary study of the Ghanaian society in relation to the subject of the thesis. Initial contacts with prospective respondents were made at various public and private institutions, organisations and businesses. This first phase extended to include a search for a convenient rural setting suitable for the study, of which two were found. There, the detailed micro-ethnography took place. The first phase actually allowed the researcher to assess the scope of the study in preparation for the choice of research methods and the design of data collection tools. At this stage, semi-structured interviews were conducted along with observation and discussion as the research methods.

Phase 2: The second phase of the fieldwork consisted more of structured interviews with Government Officials and other professionals. In all, seventeen interviews were conducted, of which fifteen are done with face-to-face personal contact and two respondents, for time constrain, could not be met in person. They however provided their responses through e-mail. One respondent, a machine-shop business owner, declined from

taking the interview. He claimed it is a waste of time, that the research outcome will go nowhere because of the spiteful attitude of the Ghanaian politicians towards technical works.

Phase 3: The final phase of the fieldwork was in effort at meeting the testing and verification requirement demanded in grounded theory. The methodology requires going back to respondents to present to them the narrative constructed; if it truly reflects the understanding they expressed. The final phase is also used to test the Ghana manufacturing of technology framework with some of the respondents.

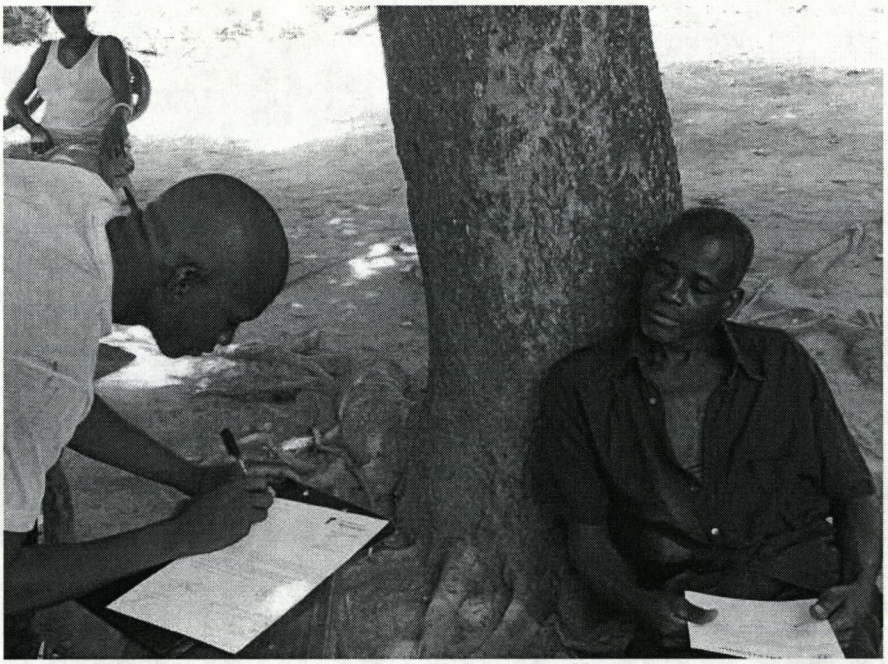
The two rural communities, here referred to as Village A and Village B, were used for the ethnographic fieldwork, i.e., researcher going to live among the native people. The first community, Village A, - after spending a week there - was found not to be sufficiently remote and technologically deprived enough for this study. This is because, it was well endowed with modern facilities such as solar panel streetlights, an ultra-modern health centre and a modern basic school. Thus, a different community, Village B, was sought.

Village B, on the contrary lacked exposure to modern amenities, thus, provided a more suitable setting for the study. The most evident modern technological artefacts found there is their water borehole provided by Ghana government for the whole community and the presence of radio, bicycles and torchlight among the residents. They have no electricity or running water. In addition, the inhabitants, only as recent as the last two decades that they no longer wore animal skin for clothing according to respondent. This suggests how for long they have been isolated from modernisation from contemporary Ghana.

In both Villages however, it was observed, as part of their customs on arrival, the researcher was taken to be introduced to the chief. In both cases, after the researcher presented his mission, the chiefs were pleased for the purpose of visit and expressed the hope that it will bring them development. Permission to stay and carry out research was therefore amply granted.

Among other experiences gained from the communities, observation was made of some of their production processes, like shea butter extraction, pottery and textile production and others either demonstrated or narrated other processes (see Figure 12 (a-i)). The process for iron smelting (see Figure 16), which is no longer a practice in any of the villages, but has its residue littered on the landscape, was narrated to the researcher from their oral tradition. Some of the respondents with whom the researcher engaged in conversations and interviews include Community Elders, women in production, mainly housewives, and school age children.

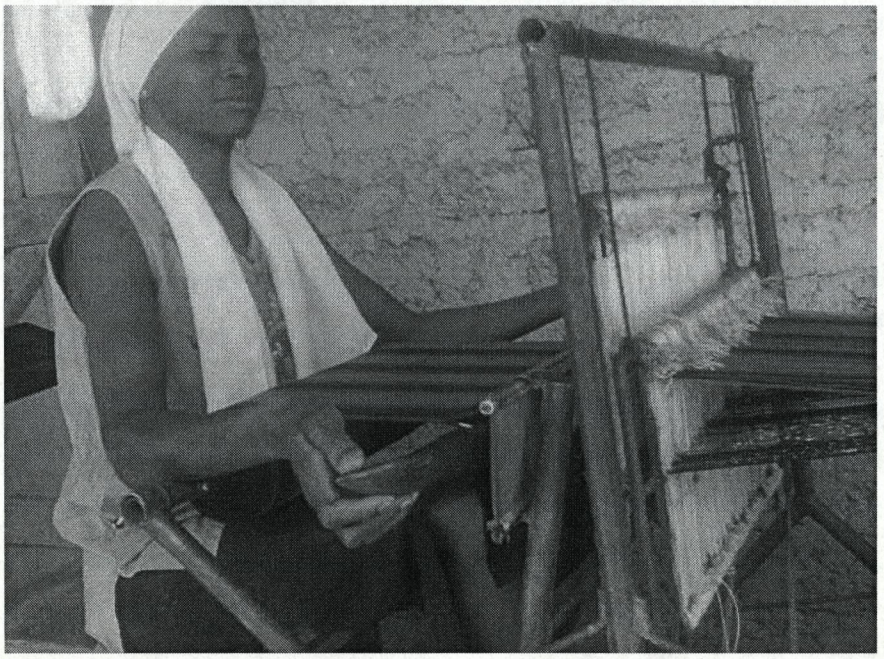
The following picture in Figure 12 (a-i) below show some key occasions during the ethnographic fieldwork.



a - Lead Respondent endorses consent of the Community to partake in the research

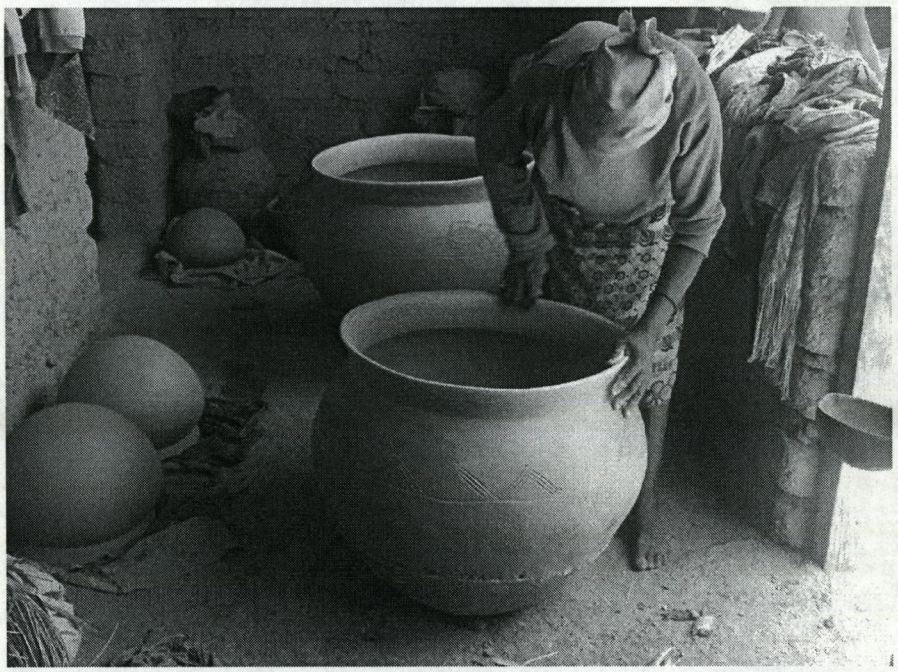
b – Researcher listening through and taking notes as Respondents relates their history from oral tradition

c – Respondents, during a semi-structured interview, narrate different traditional production processes

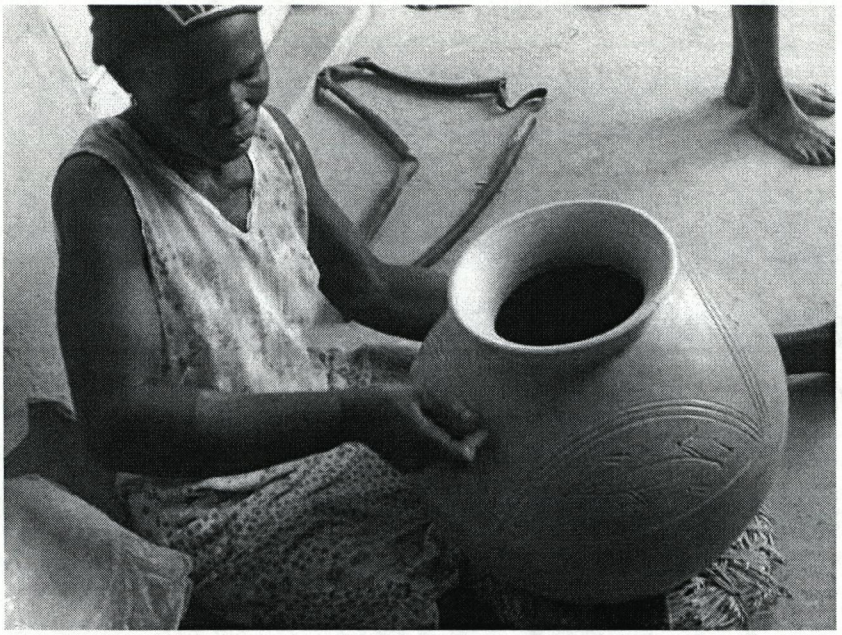


d – A Respondent weaving a traditional textile (Dagara-waja) using a traditional loom modified with metal frames by a German visitor

e – Respondent digging clay from the ground for pottery making



f – Respondent finishing up on a pottery work



g – Respondent decorating a finished pottery

h – Respondents take Researcher to view the open kiln where the pottery is heated

i – A farewell session with a cross section of the Community

Figure 12 (a-i): Selected pictures from fieldwork researcher presence and depicting culture in traditional productions

In addition to the rural experience of the two communities, an urban experience was also gained. In this case, interviews were conducted with policy makers, heads of some academic institutions, officials at government agencies and departments, private organisations including company executives and business owners. Thus, the research spanned across the rural and urban sectors of the Ghanaian society, highlighting the dichotomy and distinctiveness of traditional (rural; cultural, informal) Ghana and modern (urban; formal) Ghana and the mix of cultural presence.

Traditional Ghana, in the context of this study, is mainly rural, definable by the chieftaincy institution and characterised by high illiteracy, while modern Ghana is described to consist of the elite and ruling class which expands to include the professional group.

See Figure 13 below for the map of Ghana showing location of places visited for the fieldwork.

Figure 13: Map of Ghana showing location of visits for research (Source: Ezilion.com)

CHAPTER SIX

6.0 NARRATIVE OF FINDINGS FROM FIELDWORK

6.1 Introduction

This chapter of the thesis presents a brief account of the ethnographic fieldwork and the analyses and findings from data collected during the two periods of fieldwork undertaken in Ghana in addition to the third fieldwork aimed at data-verification also in Ghana. Data verification is required in grounded theory and it involves revisiting some of the respondents to ascertain whether the narratives (Thai et al., 2012) given below in this thesis are true representation of their position on the subject under discussion. In this verification phase, the framework developed for the manufacturing of technology in Ghana was tested with the respondents. Therefore, the narratives constructed below is obtained from and verified by respondents. It forms the theory for Ghana's technology development (or underdevelopment) and trends. The narratives, to a very large extend, avoid assumptions and speculations. And the influence of the researcher, for its subjectivity, is also greatly minimised if not completely eliminated through the revisiting and verification.

The objective of the ethnographic fieldwork is to gain firsthand knowledge from the Ghanaian (African) perspective on technology development focusing on sustainable manufacturing of technology for the local production industry. It is hoped that the firsthand information solicited will provide the basis for a fair discussion; a fair discussion based on facts and not on

speculations and assumptions; a discussion that it is hoped should explain, to a significant level (as not found in literatures reviewed), why Ghana has not been able to develop its technological base for the industrialisation of its economy, hence, remains technologically underdeveloped.

The problem of technology underdevelopment, using economic performance as yardstick, is found not limited to Ghana only as previously indicated, but pervasive in Africa and nations of African descent around the world (CIA-World-Factbook, 2014). Indeed, the list could be expanded to include nations of the Pacific Oceania States and the Americas (ibid). Its large scope is therefore a cause for much concern, hence emphasis on the quest for a clear understanding of the problem, thus, soliciting data from both traditional and modern settings in the Ghanaian society.

To aid in analysing the corpus of data collected, the social science research software package, NVivo, was used to code and query the data (see Section 5.2 of this thesis). The thematic coding, when sorted and aggregated into categories, formed a pattern on which the narratives are constructed. The pattern that emerged was not decided by the researcher, thus, reducing the subjectivity tendency associated with a qualitative research. Indeed, this was even further verified by respondents as earlier indicated.

6.1.1 Traditional Production System and Local Production System

The narratives generated from the data distinguish between two forms of production systems previously unrecognised as such. These are termed here as: *traditional production systems* and *local production systems*. These production systems are distinct from small-to-medium-scale enterprises (SMEs). Generally, the term SME is often used as an all-encompassing terminology to refer to 'young and small firms, who do not have access to public markets' (Abor and Biekpe, 2009). However, the class of emerging businesses coming up from traditional production systems, which are not considered as structured organisations (or firms), are not recognised or even known, as observed in this study. The narrative, therefore discusses this unrecognised class of producers who rely almost exclusively on their "primitive" traditional production methods describable as tedious, labour intensive, time consuming and less efficient than modern technologies.

6.1.2 Social Dichotomy in Ghana

This form of 'primitive' productions as found in this research is mostly rural based. The fieldwork experience, in addition, reveals a vivid dichotomy between the rural/urban sectors of the Ghanaian society. Likewise, tribal differences based on cultural dissimilarity appear to constitute a significant barrier to effective and mutual communication, as each tribe considers itself to be superior to the other. It is readily visible from the dichotomies how the rural sector (characterised by tribal/cultural seclusion) craves for the use modern technologies to enhance their

traditional production systems and looking up to government (urban dwellers) to provide their needed technologies. Government, on the other hand, is focused on catching up with the industrialised world for its technological advances.

6.1.3 Lack of Clarity among Policy Makers

Within the governmental setting, it is found that there is lack of clarity among policy makers and heads of academic institutions, who took part in the research, as to which government institution or setup is responsible for technology creation in the country.

In summary, this chapter provides firstly, a brief account of the ethnographic study undertaken in Ghana and secondly constructs its narratives as they emerge from data using Straussian version of grounded theory. The narratives are consequently used as the background for a case-study on shea butter production in Ghana for its technological needs (for value addition). That is to say, this Chapter therefore stands to represent the Ghanaian perspective (contained in the narratives) on its technology underdevelopment and aspiration as a way to try to identify and understand its causative factors.

6.2 Experiences from Ethnographic Study in Ghana

This section presents a summary narrative of the observations made during ethnography in Ghana. The ethnographic study covered both rural and urban settings, as previously mentioned. The rural population was found to be mainly native people and traditional (i.e. culturally minded), while the urban area is characterised by mixed cultures, i.e. consisting of people from different cultural backgrounds coexisting together. They are mainly professionals, thus, forming the elite class. This is where the seat of government resides and governmental institutions are born.

Meeting with some personnel from the professional group uncovered a general disenchantment among them regarding the low prominence of engineering activities in the country, giving particular reference to the manufacturing sector. They all expressed disappointment with regards to how nothing was made (manufactured) in Ghana, leading to the low growth rate in the manufacturing sector. Some of them blamed it on the educational system, the lack of technology and the indecisiveness on the part of the political leaders and the inability of the manufacturing sector to survive and flourish despite government's incentives. Take for example, the following response from a group of respondents when quizzed on what is imported into Ghana. Respondents reply:

> *...All kinds of machines, anything you can think of; from medical equipment to classroom teaching materials. We do not make anything in Ghana, you know. We import*

all our machines. I don't know what our universities are doing, our engineers can't do anything. We don't even make bicycle tyre (Source: Field note # 9-3).

In a separate discussion, a respondent indicated that his department (Government Department):

> *...wanted to establish technology innovation centre for capital goods where parts and components for selected plants can be produced and assembled into finished products for the manufacturing sector, but the political decision has not been taken yet* (Source: Field note # i2-a5).

Some directors from government ministries and some officials at some government agencies expressed disappoint at how government's efforts to stimulate the manufacturing sector had failed to yield any lasting result since independence. This can be deduced from the following, thus:

> *...Manufacturing in Ghana has a long history; we were exploring import substitution to develop the sector, but it failed to yield any tangible result. The manufacturing sector has not been responding to government's incentives... ....*the industries have all *collapsed. Now, our policy is agro-processing...* (Source: Field note # 13-1).

In the rural sector, on the other hand, people expressed the desire for the use of modern technology, as in machinery, to improve their local production processes. This can be seen in the following statement by some shea butter producers as

respondents who were warned the use of machines could make some of them redundant, idle and bored;

> *We won't be bored; we will be able to collect more nuts from the bush and have time to take care of our family. Machines will make the work easier for us. See us now, we are all getting old and the work is tiresome, making us age faster. If we have the machine, we can make more butter and get money to send our children to school so they can also become educated like you* (Source: Field note #15-2).

The rural/local producers, who, in most cases lack formal education, look up to government and the professional group as having all the "money", political power, knowledge, resources and capital to provide them with their needed technical solutions. The government on the other hand, as previously stated, is more globally focused; seeking to establish stronger relationship with the industrialised world (also noted by authors, such as Chevalier et al. (1992)) and it seems to lack much awareness of the technological needs of local production systems and entrepreneurs in the country's business community of local producers.

Some engineering background professionals (engineers, technicians and metal fabrication craftsmen) contacted during the fieldwork were disappointed at the Ghana government and the Ghanaian society at large for not appreciating the essence of manufacturing of technology for local productions. Such disillusionment was so strong that, as previously hinted, the owner of a private agro-processing machines manufacturing business declined taking the interview for this research.

According to the business owner, he has been very much let down by the Ghanaian system, further pronounced by the indolence from government, which is evident in its lack of adequate support for manufacturing and fabrication engineering practices in Ghana. In addition, there is a bad Ghanaian attitude towards professionals of technical background who work in the workshops. He expressed anger at the wrong perceptions that nothing can be manufactured in Ghana. In his words, the business owner stated that;

> *Ghanaians do not appreciate the work of engineering; we* [Ghanaians] *countdown on the intelligence of those who work in the workshop as if we're stupid. Our political leaders take us spitefully. I am sorry, I have nothing against you personally, but I won't take the interview, because I know your report is going nowhere. The politicians will only throw it away somewhere if it is not going to bring them money directly into their personal pockets. They are vision killers. I tell you, they are'*, he stressed (Source: Field note # 2012).

The politicians seem to be held accountable here along with the 'bad' Ghanaian attitude expressed by the respondent.

The assertion by the declined respondent suggests that the subject of seeking the means as to how Ghana could manufacture its needed technologies for national and local industry firstly is largely dependent on Ghanaians and secondly, the politicians are not supportive. That is if they (Ghanaians and politicians) choose to focus and work in that line. The politicians are seen to be highly responsible for this low attention to production engineering activities in the country since they hold

the power. This study sees as an outcome of the Ghanaian attitude being reflected at different levels of the society even at the political level.

The following section will provide further details of findings from the fieldwork constructed as narratives. The narratives provide the theory that is taken to explain, to a certain level, the African technology phenomenon, thereby, answering the research question.

6.3 Narrative of Findings from Data

This section presents the findings for this thesis from fieldwork. The Findings attempt to explain the phenomenon of technology underdevelopment in Ghana as the case for Africa. Using the techniques for qualitative research analysis in grounded theory for its robustness and narrative/theory generating capabilities, the corpus of data obtained from fieldwork provided the raw materials on which the narrative for the findings was constructed.

Section 5.2 to 5.4 briefly discussed grounded theory as used in this analysis (Corbin and Strauss, 2008, Corbin and Strauss, 1990, Glaser and Holton, 2004, Glaser and Strauss, 1967, Jones and Alony, 2011, Thai et al., 2012, Walker and Myrick, 2006, Charmaz, 2003) and the overall procedure for the data analysis. Grounded theory became relevant here as this study, owing to its research question, could not find a suitable theoretical narrative or framework (see Chapter Two, Three and Four of this thesis) that adequately explain the Ghanaian scenario of technology lag, thus, the need to generate its own narratives from data for explanation.

As indicated in Chapter Five of this thesis, grounded theory was split along the lines of the 'discoverers' of the theory i.e. Strauss and Glaser, leading to the Straussian or Glaserian version (Walker and Myrick, 2006). This study found the Straussian approach (Thai et al., 2012), as it allowed working from a previous background knowledge, use of research question and inductive and deductive strategies used interchangeably (Bernard, 2013, Corbin and Strauss, 2008).

As earlier stated, a lot of background study went into the early stages of this research. More so, the researcher's personal experience as a Ghanaian cannot claim to be completely eliminated from the study. However, caution was taken to prevent personal experiences from clouding the outcome of the study. This was controlled through the verification phase of the fieldwork, by revisiting some of the respondents to crosscheck the narratives generated from data. The aim is to ensure that the narrative generated is actually grounded in the data obtained from them (the respondents). Respondents were therefore required to ascertain if the narrative presented truly reflects their view.

Some of the findings, however, rather tend to confirm existing literature, which in certain cases could be considered as common knowledge. Though they may not be new, they nonetheless go a long way to show their relevance to answering, at least, part of the research question and sometimes leading to new interpretations to the meanings currently attributed to them.

The following narratives were therefore constructed as they emerged from data obtained from the fieldwork using the Straussian version of grounded theory.

6.3.1 Dichotomy in the Ghanaian Society

Observations from fieldwork indicate that Ghana is polarised between a traditional and modern lifestyle, split along rural and urban setting respectively. This is found to agree with the work of Chevalier, et al. (1992), Sachs (1992) and Austin and Headrick (1983).

The traditional sector being rural is often considered as lacking formal education. It is culturally minded and ethnic in appearance. Generally, and as also observed in this study, it is characterised as being highly communal, thus, a collectivist society (Hofstede, 1984). The formal or modern sector, on the other hand, being urban, comprises of the professional group and the ruling class and holds the power of the government state.

The overall Ghanaian society, besides the rural/urban split, is found in this study, to be divided along ethnic lines, Ghana being a multi-ethnic and multi-cultural society (see Chapter Two of this thesis). As noted by a scholar and found to be consistent with this study, the multi-ethnic structure of modern African States, of which Ghana is one, does not serve for its socio-political, hence, economic and industrial advantage, as integration is hampered by several factors (Phiri, 1985). These dichotomies hamper integration and effective communication therefore needs a bridging mechanism to enhance integration and cohesion among the various ethnic and rural/urban societal divides. Thus, within the scope of this study, Ghana, in the interim, might have to seek such a mechanism or channel for its technology creation and development in the face of the apparent dichotomies. This is referred to in this study as; a *sense of commonality* is required

for breaching the social, cultural, ethnic and political divides to lead towards a drive for technology creation.

6.3.2 Ghana and the Technology Creation Saga

This sub-Subsection is an attempt to generate the narrative that discusses why Ghana's struggle to industrialise its economy is marred with persistent unsuccessful attempts since independence in addition to the dichotomy discussed above. The narrative, as a point of departure for the discussion, will begin from the *traditional setting* (rural), its marginalisation from modernisation by the elite group and then move on to look at the complication in the relationship between the *local producers* and modern Ghana for its bureaucratic processes (Price, 1975). The work of Price (1975) showed that the introduction of Ghana into modern administrative processes was very problematic to its traditional setting, as is the case in most Africa. These processes are bureaucratic in nature and could be described as being alien to the traditional African (Ghanaian) culture. There will also be an attempt to present a narrative from respondents on the impact of the global world of technological advancement, with specific reference to multinational corporations on local production systems in Ghana. The discussion will further highlight Ghana's policy makers' new strategy towards industrialisation. This new strategy is however found to lack strong emphases on technology creation in the country. It rather seeks to prepare suitable workforce in anticipation for prospective investors. The narratives are here thus presented:

i. Traditional Sector Inclination towards Modernisation

A recent demographic change in Ghana as reported by the Ghana Statistical Service (GSS) in June, 2013 (Daily-Guide, 2013) indicated that for the first time in the country's history, more than half (50.1%) of the economically active population live in urban areas as opposed to previous demographic distribution where majority of the population lived in rural areas. [Recall: the rural area is considered to be deprived, reserved for the poor and illiterates.] This demographic shift of "new" urban residents might be the outcome of the rural/urban migration of the youth in search for a better life (Adepoju, 2010). The concern in this shift, for this study, is the possible further marginalisation of the rural areas for their now thinning population, especially for the vital resource of the youth.

Some of the experiences gathered from the rural areas during fieldwork include a realisation of the absence of the youth among the population, which consisted mainly of the elderly and children. Take for example, as commented on by one of the village Elders;

> *... Now we are old, we do not have the strength to farm and our children have all gone to live in Kumasi and Accra to look for work. There is no work here in the village, only farming. It is a hard job. We are suffering* (source: Field note #4-27).

The view expressed by the Community Elder and the new statistical demographic data suggests a shift from traditional systems of operation towards a quest for modernisation.

It was noted how traditional processes for making things were inefficient and tiresome. Indeed, some Africanists authors like Austin and Headrick (1983), have noted from history that Africa's traditional technologies rely solely on man-power for all their production systems. 'We are suffering' was a common phrase encountered during this research and it is believed to refer to the exhaustion from the fatigue of manual production systems, hence their desire for machines to aid in their processes.

The indigenous technologies at the traditional level are very rudimentary, as observed. They have been left undeveloped since they were known. Rural life, lacking viable local industry, has therefore become unattractive to the youth, as there are no economically rewarding activities to engage them. The world is leaving them behind so they move to follow up.

There seems however to be a strong desire among the traditional local producers (rural dwellers), to use modern and efficient technology for their productions, as indicated by respondents. They however condescend to a fatalistic position of mindset that the afore-desired technologies cannot be created by them despite their strong inclination to use such technologies. Their use of traditional technologies does not show any inherent impetus that will stimulate a quest to improve on them; hence they have remained undeveloped ever since the days of their ancestors.

ii. Traditional Technologies and Production Narrative in Ghana

The traditional system of production, as observed and deduced from respondents, is labour-intensive, tedious, comparatively less efficient, time consuming and generates commercially little or no profit, and hence, unviable for competitive business. As such; African productivity is deemed uncompetitive according to global standards (Lall and Pitroballi, 2002). It has been argued in this study that the drawback (uncompetitive-ness) in African production ensues from the lack of inherent technological growth in the African society, now seen as demurring to the technical capability of the African peoples and nations. This gives the impression that Africans are incapable of showing scientific or technological acumen, as suggested by some authors.

Indeed, authors like Davidson et al., (1965) have shown that some Africanist historians refer to the African society as not having its own history and other scholars from the fields of economics and technology development have shown that some Africanist writers dismiss the instincts in Africans towards technology development (Austin and Headrick, 1983). To buttress such position, the authors have argued that though Africa may have a form of technological trajectory, its technology remains undeveloped owing to its cultural practices and interpretations. Others also argue that Africa's lack of efficient institutional framework explains its underdevelopment (Acemoglua and Robinson, 2010, Johnson et al., 2003, Szogs et al., 2009).

Contrary to such position, findings from this study, and in line with the views of some authors like Davidson et al., (1965) and

Boahen (1966), have shown that Africa has its own history and its own technology development trajectory, but these technologies, as previously noted, have been left in their rudimentary undeveloped state. Figure 14 below shows examples [in three pictures from Ghana] of some of Africa's technological heritage. These traditional technologies, as can be seen, are manually operated, tedious, laborious and time consuming, as earlier indicated, with an efficiency level which leaves more to be desired, but that does not equate to inexistence. It is here established that traditional Africa has its technologies, only that they have not been improved upon, hence, still rudimentary.

Looking at the pictures from left to right, the first shows three women pounding in a carved wooden mortar, with each using a pestle; the middle picture is a boy playing his traditional melody on the xylophone made from strips of specially treated wood and gourds; the last picture shows the weaving of a traditional textile, called *Dagara-waja*.

Figure 14: Showing different forms of African traditional technologies in use (Source: Fieldwork).

Figure 15 below shows a family house in the farming community depicting Africa's traditional architecture. These are all, indeed, technologies – technological artefacts.

Figure 15: Traditional architecture – a village farmer's house in Northern Ghana (Source: Fieldwork).

The oral tradition of iron smelting, as obtained from the respondents, shows its well-established position in the society in making tools and weaponry in the ancient days. Residues of iron smelting activities are seen littering the rural landscape as a strong evidence of its previous presence. Though, now no longer a lucrative venture, as iron plates are cheaply available on the local markets brought in from elsewhere, authors like Austin and Headrick (1983) have shown how Africa's smelting technology was in advance of that of Europe, but was short lived and did not lead to technical change.

Respondents, narrating the wisdom of their ancestors as to how they obtained iron from smelting, gave a pictorial description of the process. Their description is illustrated in Figure 16 below.

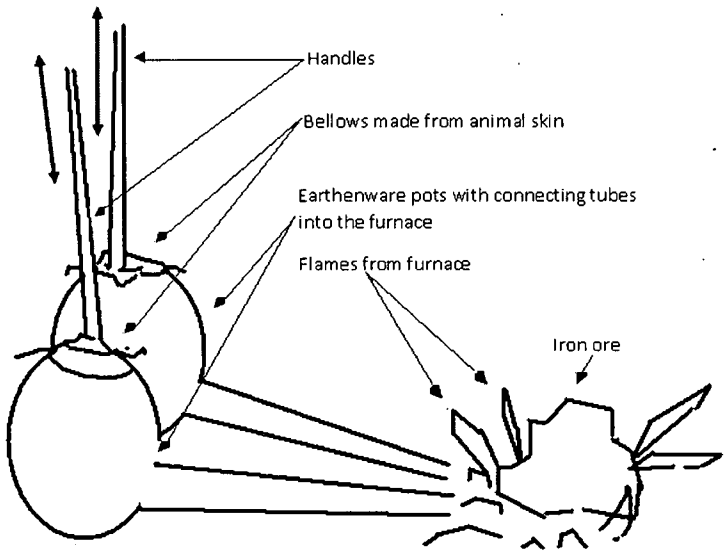


Figure 16: Description of a traditional iron smelting (Source: Fieldwork)

According to their narrative, their forefathers obtained iron from a special kind of rock called '*bensa-kwansibe*' (iron ore), which was heated in a special fire place called '*saab*' (open furnace). See Figure 16 for illustration of the iron smelting. Various grades of iron, according to one of the elder's narration, could be obtained depending on the quality of the '*bensa-kwansibe*'. Depending on the grade, the iron obtained was used for various purposes, such as; making arrow-heads for hunting and war, hoes, machete, axe, iron helmet, jewellery for their brides, and other artefacts of value.

When asked why they stopped smelting iron, the Elders responded that their blacksmiths get iron plates to buy cheaply from the market nowadays. So they do not need to go through the trouble of processing the ores themselves anymore. They described the process as being a very tedious task.

Taking the premise of the African rudimentary technological heritage, therefore, the assertion by authors that Africa does not have its own technological base can be challenged on the basis that African technologies were developed independently from the rest of the world. The continent therefore possesses the potential for development and growth with the appropriate stimuli. The emphasis therefore should be on finding ways (i.e. the appropriate stimuli) to improve on these technological systems embedded in African cultures.

Authors like Austin and Headrick (1983), though recognising the technological trajectory of Africa went on to argue that the very essence of African culture accounts for Africa's technology underdevelopment, whereby African children lack creativity.

Such claim is found to be contradictory to the experience of this study and can therefore be momentarily discarded on the grounds of the ethnography undertaken in Ghana. The fieldwork saw Ghanaian children to be highly creative, making toy cars and helicopters from cans and other artefacts like bird cages, traps for rodents and other products without adult involvement. By this finding therefore, the authors' argument that Africa's cultural method of child rearing impedes their creativity does not hold. The question that comes up however is, why are the African adults unable to convert such childhood creativity into a competitive edge for commercial production?

Taking the above authors' perspective of technology underdevelopment further, it may be helpful to ask what technology is. Within the context of this study, technology has been defined (see Chapter 4 of this thesis) from the work of Khalil (2000) as involving all the knowledge, products, processes,

tools, methods and systems employed in the creation of goods or in providing services. This is understood, in simple terms, to imply that, technology is any event (products or services), other than those occurring naturally in nature, that is, anything that has received any form of human transformation could be described as *technology*.

By this understanding therefore, it can be stated that technology and its creation in human society is intrinsically linked to the rudimental needs of the society, but not dictated by its cultural disposition. Culture in itself could be seen as a product of society, as it is determined by surrounding factors and the mindset of those confronted with such factors as in 'the programming of the human mind' (Hofstede, 1984). Hence, culture being a product of society is thus shaped by the society and in turn shapes the society, just as artefacts and technologies are shaped by society and vice versa (MacKenzie and Wajcman, 1999, MacKenzie and Wajcman, 1985, Williams and Edge, 1996). The perceived "needs" and mindset of a society therefore defines what technology it aspires to or creates for itself, thus, the claim by some scholars that the African cultural disposition and interpretation is the inhibiting factor to developing their technology could be considered as a misconstrued representation of African cultures. The misrepresentation displayed by the authors for coming to such conclusions, is probably derived from not obtaining firsthand knowledge of the African (Ghanaian) perspective of cultural interpretation and societal description, but rather based on speculation driven by the scholars' 'invisible ethnocentrism' (Chevalier et al., 1992).

Having said that though, it is not out of sight how Ghana and sub-Saharan Africa as a whole lacks a trend for technological development or a strong technological base. The challenge now is how to establish an approach to develop its technology in a sustainable manner. To do this may require a level of extensive knowledge of the description of the Ghanaian society in relation to its traditional production sector in efforts to augment its modernisation drive towards industrialisation. It is the traditional sector that holds the indigenous technological heritage of the African (Ghanaian) society, hence, its relevance.

iii. The Traditional Sector in Modern Ghana

The traditional sector in Ghana, and in fact common with other African countries, could be said to be represented by the chieftaincy institution (Boafo-Arthur, 2006, Odotei and Awedoba, 2006, Beall and Ngonyama, 2009, Englebert, 2002, Kleist, 2011).

In Ghana, the chieftaincy institution, though recognised by Central Government and institutionalised in the 1992 constitution, is marginalised from decision making on matters of science and technology and debarred from partisan politics (Government-of-Ghana-Official-Website, 2013, Beall and Ngonyama, 2009, Englebert, 2002, Kleist, 2011, Chieftaincy, 2012). In a similar manner the traditional institution as a whole is notably isolated from modernisation decision making processes (Chevalier et al., 1992, Price, 1975). The traditional sector therefore is 'confined' to rural settlements to cater for itself to a very large extent. It thus, relies almost exclusively on its rudimentary technological heritage, while the modern (formal) sector is focused a lot more on getting westernised. This was indeed, as previously indicated, noted by scholars like Chevalier and his colleagues, thus:

> *African governments too often find themselves in the middle of the picture, trying to maintain a viable relationship with the OECD countries and the African modern sector* (Chevalier et al., 1992)-(pg. 367).

This observation by the authors is found to be true, as noted in this study, among some policy makers in Ghana. They place the emphasis on catching up with the industrialised world by obtaining funding to develop such high-tech industries as nano-technology while traditional technologies received no attention for upgrading. This could be deduced from a policy maker's statement, thus;

> *...we are improving technology with Chinese funding, we will build science resort centres to develop things like nano-technology* (source: Field note –#i1-a6).

The traditional sector is making much effort to embrace modernisation but government policy is shifting away. It has been shifting from its strong conservative position (Beall and Ngonyama, 2009) and abandoning what may be termed outmoded and unproductive customary practices and taboos (Boafo-Arthur, 2006). This can be confirmed in the words of a respondent from the following statement:

> *...in the past, men were forbidden and not allowed to touch any item used in the shea butter preparation or touch any part of the process. It was a taboo; if they did, the process was believed to have been defiled and it will have to go through a purification process. But nowadays we don't have that taboo anymore...* (Source: Field note - #4-42).

The sector is therefore making much effort by itself to modernise even to the point that it compromises on its customary practices and changes its traditional stand. This can be seen even in the chieftaincy institution, which now seeks only to install chiefs who have attained a level of formal education and those with experiences from abroad (Kleist, 2011). Despite these remarkable efforts the sector is still marginalised as observed in this study.

The traditional sector, as such, is typified largely by illiteracy and disconnection from Central Government administration. This may account for its marginalisation from the formal structure of government and input to the pursuit of industrialisation. The traditionalists, limited by the absence of formal education, are mostly engaged in primary production such as farming, fishing and handicrafts. These are generally small-scaled productions with limited ability to add value to their products. Value addition has become a major impasse in their production systems as it requires a higher level of technological application, which is traditionally lacking from the sector.

As the sector is mainly located in a village (rural) setting with limited flow of knowledge of/from the outside world, they rather become the object of exploitation by professionals arriving from the cities in their "big cars" as described by a respondent. According to the respondent, the village folks referred to them as the "big-men".

These 'big-men' contract the peasant farmers, engaging them in specific crop cultivation, but end up sometimes not paying the farmers. According to the farmers (as respondents);

> *...Some big-men bring us chemicals, including fertilizers to spray our farms, but they are not good for us; the harvests go bad early during storage. They are not good, but the big-men from Accra tell us to keep on using them and make us farm for them. Sometimes they don't pay us. The last time, about three years ago, they came and took the crops away while we were working in our forms, without paying us. They left a letter on our doorstep. We cannot read so we took the letter to the Police Station and every time we make a follow-up, the Police only tell us to come tomorrow. Now we stop following up on the letter* (source: Field note #4-26).

It may be suggested here that the peasant farmers (representing the traditional sector) seem to be exploited by organisations coming from professional institutions. In addition, they appear not to be well attended to by State institutions like the Police designated to protect the citizens of the country, including the traditional, illiterate, rural peasant farmers. This could serve as one of the signs of marginalisation of the traditional sector from participating in the modernisation process.

Thus, marginalisation of the traditional sector could be considered here as a contributing factor to the unsuccessful attempts by various Ghana government regimes to industrialise the national economy (Lall and Kraemer-Mbula, 2005, Lall and Pitroballi, 2002).

A framework for dialogue and participation to integrate the traditional sector into government's schemes for sustainable technology development is desirable. This may involve identifying which institutions (such as tertiary academic

institutions, research institutions, the legislation, etc.), may play key role in the integration process and define their specific roles within the context of developing traditional technology (TT) systems for local productions.

iv Properties and Dimensions of the Traditional Sector

The traditional sector, in this study, is understood to constitute the section of the Ghanaian population which relies mainly on traditional methods of production, as opposed to modern methods. This sector appears to await full amalgamation (or fusing) into the modern stream of development. As previously noted, it is predominantly confined to the rural setting where, the majority of the population lack formal education, hence, relying on the heritage of their culturally distinct traditional production and livelihood.

Thus, within the scope of this study, some dimensions of the traditional sector are contained in its rural settlement, culturally distinct processes of production, limited attainment of formal education and an inherently constrained production capacity.

As identified in this study, the sector does not seem to be well understood by Ghana policy makers and government officials in relation to its production systems and relevance to the industrialisation intent of the nation. The traditional sector, on account of its cultural affiliation and sensitivity, is generally perceived as an 'anti-state' institution (Kothari, 1997), thus, a seeming threat to the government establishment and/or machinery , and as such, receiving less attention. This, however, should not be case, as it could form part and parcel of the state structure and can subsequently be used rather as a vehicle for

development, here, of technology; technology, a tool for state survival (ibid). The aim here, therefore, is an attempt to provide some insight to better understand the traditional sector by further outlining its properties and the dimensions the properties may assume. These are:

1. Late Entry of the Concept of Development: - The traditional sector is here argued to be vital for the development of technology for the socioeconomic development of the country, hence, its relevance in a framework for dialogue and participation.

The sector, as earlier mentioned, is headed by the chieftaincy institution which wields much power over its subjects (Kleist, 2011, Odotei and Awedoba, 2006, Boafo-Arthur, 2006). The institution, though deeply rooted, but not immutable (Beall and Ngonyama, 2009), is keen to partake in development. This can be deduced from this researcher's experience when introduced to the two Community chiefs during the ethnography in Ghana. The chiefs were grateful for their communities being chosen for the study and requested that the research brings development to their villages. Also, taking a note from the field notes of Williams (2000), cited by Englebert (2002), African chiefs are seen to be desirous of development as can be deduced from the statement below;

> *...the inkosi* [chief] *told us that bringing development to the community has been his most important duty since 1994 when he and his community first learned about development* (Source: Englebert (2002)).

The above quote from the *inkosi* and the experience with the two chiefs could be seen as suggesting the late entry of the concept of development into the African traditional mainstream. This notion could also be deduced from the work of Herbst (1997), who showed how; it was during the era colonial administration in Ghana, then, the Gold Coast, that the concept of economic development was introduced to the inhabitants of the coast.

2. Desirability for Technology: - The desirability for development is found not only within the traditional elites, as in the chiefs, but also among local producers relying on traditional (indigenous) production methods. This was deduced from home producers and a group of women working in a local shea-butter factory (see Figure 17 below) who are calling for the use of machines to assist them in their productions.

The local factory owner and workers claimed they could not afford any machines, hence, worked with humans as machines. Their desire for machines can be deduced from their statement as provided below that they want to use of machines. They responded thus;

> *…. Machines will make the work easier for us. See us now, we are all getting old and the work is tiresome, making us age faster. If we have the machine, we can make more butter …* (Source: Field note #15-2).

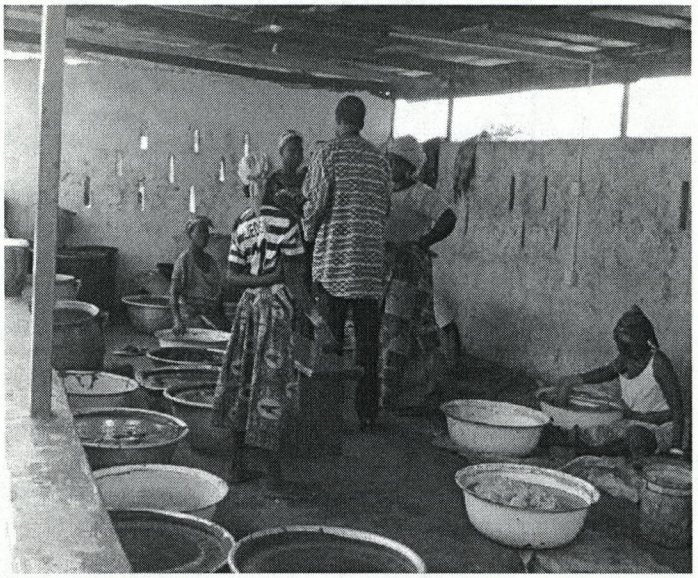


Figure 17: Workers at a shea butter processing factory expressing their need for machines (Source: Fieldwork)

Such expression for the want of machines was not an isolated request. The researcher encountered similar situations at all traditional production sites, whether home productions or local factories. For example, researcher meeting respondents at a local factory for traditional palm kernel oil extraction (see Figure 18 below) received similar requests. The workers, again mainly women, presented their request in very similar wordings to the shea butter factory women, calling for the use of machines to relief them of the fatigue in their production processes. There also, like the shea butter factory, all their processes are manually operated.

Figure 18: Palm kernel oil extraction factory (Source: Fieldwork)

The traditional sector, within the findings of this study, lacks modern technology and relies almost exclusively on indigenous "primitive" technologies and methods in all its productions. The sector, not able to develop its technology by its own initiative, i.e. lacking the social stimulus and drive to improve on indigenous methods of production and still relying on the "wisdom of their ancestors", provides the basis to infer, as identified from literature (see Subsection 2.3 of this thesis) that the traditional people have, somewhat, lost the ability to develop (improve) their own systems, artefacts or methods of production by themselves. They require some external force to help.

To regain this "lost impetus to development", in accordance with the perspective of this study, will require working towards improving traditional production methods through a systematic government intervention, while keeping its international relationships. For an effective intervention, the traditional sector will need to be understood, and properly recognised to harness

its resources. This is the feat this study hopes to provide a framework to achieve.

3. Ethnic Seclusion: - Beside the late entry of the concept of development into the traditional sector and the seemingly absent indigenous initiative to develop own technology or assimilate modern technology, the sector is highly divided along ethnic, cultural and geographical lines (see Figure 1 for the ethnic map of Ghana showing the various ethnic settlements).

African society is often described as ethnic (Lentz, 2006, Osaghae, 1991, van den Berghe, 1983) and its ethnic divisions are deeply accentuated (Odotei and Awedoba, 2006).

The occurrence of the division in Ghana cannot be left without mention. This can be demonstrated by the statement of a respondent in a rural setting, when asked how his tribe related with neighbouring tribes; he states:

> *We are different people from them; they speak different language so we do not relate very much with them, we sometimes intermarry, but it rarely happens. We trade with them sometimes, but not very often; we could trade guinea corn or yams and pay with cowries, but cowries are not very common anymore, so we use cash* (Source: Field note #4-37).

The respondent's assertion, among other things, confirms the division is rooted in the Ghanaian society and in fact, it cuts across the country, reaching to the modern sector. This was indicated by a separate respondent, a senior official from a multinational company;

> *...the simple fact is that an Ashanti man will not want the Ewe man to be his boss, likewise the Ewe man. The Dagomba man, Gurshi, and the rest, no one will want the other to be his boss. Look at the political parties; see how they are divided on tribal lines; the Ashantis to one side and the Ewes to the other. No one wants the other to rule over him* (Source: Field note #2-6).

Knowledge of the ethnic divisions is significant in this study, in that, to a very large extent, it helps to explain some of the reasons for internal social and cultural barriers to development. According to the ethnologue languages of the world, as previously indicated, Ghana has seventy-nine living languages (Lewis, 2009a), this excluding the dialects. Thus, using language as a basis for cultural classification (as mentioned earlier in Chapter Two of this thesis) implies that Ghana has several cultural divisions inherent in the society. The elite group could also be classified as an additional cultural group. Such vast non-integrating cultural mix suggests a lack of socio-cultural coherence in Ghana. Such a mix could be argued to lead to a higher level of internal conflicts as compared to a mono-cultural society. A 'sense of commonality' (for development) cutting across all social, cultural and ethnic barriers therefore needs to be sought in this case.

4. Tribal and Gender Division of Labour: - Tribal seclusion seems to be made possible by the 'self-sufficiency' of a community in the traditional sector village setting. Such settings adopt a particular mode of subsistence way of life culturally peculiar to them. This may include the type of economic activity they engage in, for example, farming, fishing, cattle rearing or a

combination depending on their location; if living on the coastline or the savannah region. They specialise in their choice of vocation as a tribal heritage and see other forms of economic activities (outside their choice) belonging to other tribes. For example, a respondent explains why he will not partake in gold mining near his village community despite the financial rewards involved;

> *...No, we* (our tribe) *are farmers, we don't do gold. We don't know mining, they know it, it is they who do it* (Source: Field note #3-5).

This suggests a setting of *tribal division of labour*. It is however not clear why such division does not lead to increased inter-tribal dependency, interaction and dialogue. Rather they keep to themselves (seclusion) having a strong kinship and family ties, while inter-tribal relations remain slack, weak and sometimes hostile.

The reader may recall from Chapter Two of this thesis the work of Price (1975) showing how the Ghanaian society is structured along family lines, such that the unit of the society is not the individual, but the family.

Similarly, certain jobs are culturally set to be gender specific (Austin and Headrick, 1983) for some of the tribes in Ghana. For example, shea butter processing in Northern Ghana is seen exclusively as a woman's job. And at the coastal regions of the country, deep-sea fishing using boats is exclusively reserved to the male gender as a profession too dangerous for a woman to partake in. The women engage in trading the fish.

v. Traditional and Local Production Complications

The emerging narrative of local industries in Ghana, within the context of this study, distinguishes between two identical forms of indigenous producers in the traditional setting. For convenience, these sets of producers are classified as *traditional producers* and *local producers*. The separation of the terms is to enable the build-up of the discussion so as to highlight certain intricate and salient observations, which are overlooked and thus, not recognised in the domain of public discourse.

To establish a common ground for discussion, the following understanding will be accorded the afore-mentioned terms henceforth:

Traditional producers or production, refer specifically to those engaged in indigenous (primitive) mode of production for livelihood and subsistence. This mode of production relies solely on the rudimentary traditional technologies previously described, which are culturally inherited. This implies a non-commercially intended rural based production system. Example, housewives engaged in household shea butter production mentioned earlier.

Local producers or production, on the other hand, could be seen as those involved in the traditional production system that attempt to combine the rudimentary technology with a higher form of technological approach to aid its production efforts. Local production is therefore a step towards modernisation, though, still essentially rudimentary, i.e. a step beyond traditional production. It could therefore be rural or urban based, unlike the former, which is exclusively rural based. Example here is the afore-mentioned [women at] the palm kernel oil production or the shea butter factory, where humans work as machines.

A noticeable difference between the production systems of both producers is that the system deemed local productions are those principally aimed for a commercial purpose (comparatively larger quantities), while traditional productions are simply for home or family usage only, with any small surplus exchanged with a neighbour or a visitor (tourist) for cash. There is no intended trading in it, it has no setup or structure, but local production is "customer" oriented and seeks a market, though the product range may be the same e.g. shea butter, oil palm, gari (processed cassava), etc.

Local producers here are perceived as entrepreneurs. They make personal efforts to create (concretise) a shift from traditional production, by working towards legitimising their production practices; like setting up a government recognised and registered enterprise, subjected to the laws of business such as paying tax and keeping to certified standards. Local production, in simple terms is describable as working towards, or being very similar to small-to-medium enterprises (SMEs) (Thai et al., 2012), yet it should not be confused with the same. SMEs are statutorily recognised and have definite structure (Abor and Biekpe, 2009, Frazer, 2005, Teal, 1998), while local production is simply emerging from "primitive" traditional productions only with a business intention.

In comparison to SMEs, local production is characterised by much lower production output, use of renewable energy and locally available inputs. Its production actually caters for the material needs of a large proportion of the Ghanaian population as they are locally widespread, albeit lacking an enabling technology or any form of formal recognition unlike SME's.

As stated above, local production emerges from the traditional production system, which is still very rudimentary. This may be understood to imply that local production systems might be considered as green horns, inexperienced and emerging feeble business entities, requiring all the needed support. Some of the systematic support could include secured market availability, legislative and legal support, guidance on standards, certification and others, such as infrastructure and needed technologies. No such support is found available at the time of writing this thesis probably because the existence of the local production system is not known or recognised. The existence of SMEs seems to overshadow any form of local production efforts. Such broad categorisation overarching local productions denies it of attention.

The question however is; who is expected to make the provision? In the case of Ghana where the private sector is weak (Aryeetey and Fosu, 2008, Frazer, 2005, Government of Ghana, 2010, Johnson et al., 2003, Lall and Pitroballi, 2002, Price, 1975, Republic-of-Ghana, 2011b, Szogs et al., 2009, Teal, 1998), the first benefactor that comes to mind is the government. Government is expected to provide a certain amount of facilities and infrastructure in addition to a general framework for a business environment where production/manufacturing can take place, with adequate provision to recognise and promote the local productions in general. However, treating the local production system with the same yardstick as a multinational corporation seems to be highly problematic.

Local producers are not conversant with bureaucratic processes of government institutional structures and arrangements. They also lack the general knowledge "power" of affordability to

acquire the necessary technologies (machines) to enhance their productions to become more competitive. This problem of lack of technology is also akin to SMEs in Ghana (Association-of Ghana-Industries, 2010), which are invariably unable to upgrade their technologies, thus, leaving them no choice other than reliance on the use of obsolete equipment and machines. This was deduced from respondents in the research.

Local production is therefore faced with much complication as it is not yet a known system for its needs to be addressed. The following subsections may provide a brief highlight of some of these complications, which is mainly an issue between State institutions and the emerging local-producer entrepreneur followed by the attitude of Ghanaians towards local production.

vi. State Institutions and Multinational Corporations in Relation to the Emerging Local Production System

Local producers, in the context of this study, are entrepreneurial, hence, energetic and enthusiastic, as entrepreneurs are deemed to be (Sexton and Bowman, 1986) in their "newly" found "amateur" business venture. They see their new vocation as promising, and thus aspire to make it grow eventually into an SME though not conversant with its complexities and bureaucracies (for lack of formal education), and therefore later face difficulties. The case of a local soft-drink producer encountered in the study epitomises this scenario as described in the succeeding paragraphs.

As alluded to above, this is the experience of a soft-drink producer, as a respondent and a *local producer* [entrepreneur] who wants to add value to his locally known traditional soft drink.

He sought to do so by standardising the production processes. He was inspired to thus grow his business when he realised his initial *traditional production* was attracting a wider customer base and penetrating into the local market beyond the confines of his village into the towns and cities. When asked to tell about his products, he went thus;

> *They were all soft-drinks, three different types; two were fruit juices and one was made from the flowers of a plant we call 'bissap'. It is the traditional drink from my village, we take it a lot. It's very refreshing for sunny days and the business is lucrative. It is a whole family production; actually, even my mother-in-law is given charge of the production* (Source: Field note # 17-1).

According to his narrative, he took the opportunity to increase his production and standardise it according to the laws of the country. He consulted with the relevant institution and presented samples of his product to the appropriate officers. They were impressed and advised him to further test the market before coming for certification. A take from the respondent might be helpful here. When asked why he stopped production, he went thus;

> *I think it was our fault; we went to the [agent's office]* (actual name of institution withheld) *to get certification for the drink; that was our mistake. The Officers told us to test the product on the market much longer to be sure of its success. Within that same week of our meeting them, they sent their taskforce to inspect all shops to remove all uncertified products. So they went and collected ours too. I went back to their Office to remind*

them of what they told me when I came there all by myself the first time, but they just insist that any item not certified had to be destroyed. I took loan from the bank to increase production at that time, but they stopped my business. I had to look for money elsewhere to settle the loan. That is what has spoiled that business for me (Source: Field note #17-4).

The local producer, in an effort to comply with government regulations became a victim of what is yet to be better understood. For example; he heeded their advice to further test the market with his product. To adequately test a wider market he considered it necessary to increase his production so as to widen his market base. This led him to contract a loan from the bank which enabled him to successfully increase production to supply to the local shops. That same week, however, the certification body ordered a taskforce to rid all shops of all uncertified products, including those of the respondent. When the local producer contacted the government agency to enquire the seizure of his products despite following their initial directives, they simply insisted that uncertified products must be taken away. The local producer therefore lost all his supplies to the shops, hence falling victim to State machination; his aspiring soft-drink business collapsed, leaving him with the loan to repay. When respondent was asked whether the matter was taken to court, he explained that his previous experiences with the court have eroded his confidence in their proceedings. He referred to the thought as a waste of time and money. He mentioned how the court clerks always demanded huge unofficial payments to retrieve one's files for the case. He stated; his dream and

business was ruined, and he did not know how he was going to pay back the loan.

A follow-up visit by the author of this thesis to the government agency in question to verify the local producer's narrative received no denial from the officials. Indeed, an officer at the agency pointed to the fact that the Heads and Directors of the agency are political appointees who generally lack vested background knowledge of the expertise and operations of the agency. Among other things, the officer indicated that indigenous productions were not accommodated by the agency; stating for example, filling the certification forms was a complicated process for an uneducated entrepreneur to comprehend. In addition, the officer brought to the researcher's notice some controversies that exist between similar government agencies. Example of such is the duplication of functionalities in different agencies leading to tension that sometimes arise between such dissimilar agencies like the Ghana Standard Board and the Drugs and Foods Board, or similar institutions like the Polytechnics and the Universities.

The local producer's narrative therefore suggests that government institutions require greater clarification to their mandates and it appears some do not have a supporting framework in place to promote the operations of local production systems. More so, better clarity is again required among government institutions regarding their specific and broader responsibilities, especially as they sometimes conflict on similar roles, thus, possibly inhibiting their prospects of identifying future areas for development such as making provision for local technological growth.

Indeed, the above scenario of the local producer does not appear to be an isolated incident. It seems to assume a regular occurrence linked to the forces of multidimensional corporations in association with the Ghanaian political setup. Their form of relationship seems to work against the *local production systems*, making it difficult to break through with their business aspiration, thereby, hampering local technology development. This assertion was deduced from a different respondent who runs a major grocery shop in another town in Ghana. The respondent alluded to the political system in Ghana as a reason why her husband, though seeing the prospects in the shea butter industry, was not going to set up his production business in Ghana. She stated thus;

> *...unfortunately, all these things have their politics as well. If you get into production, you will become a threat to the American company and they will work through our politicians to stop you from taking away their market. I can't tell you all, it's very complex. Right now as I speak with you, Ghanaians, including my husband, are in US and Europe and other places like China, looking for buyers for our shea nut. They can't come home to start shea butter production, because they know these things. It's a mix up confusion* (Source: Field note #16-3).

This suggests that local producers are not supported by the institutional structure of the State. And the producers, on their part, have low or no confidence in the country's legal and judiciary system for redress. Government itself seems overwhelmed by the "power" of multinational corporations, as

indicated by a different respondent when quizzed on the current success of his company, which was previously State-owned but now privatised and foreign-owned. Respondent replied thus;

> *In those days, we only supplied to one big multinational company who had the monopoly and tried to retain it. So whenever any government came up with a policy to try to take control of our productions for diversification and maximisation of output for higher profits, the multinational company simply warned that government in power not to implement such policy otherwise it will withdraw its commodities like soap, sugar, and others, from the market and the population will revolt. The government, careful not to become unpopular, then withdraws its position. As a result each government's attempt becomes powerless* (Source: Field note #2-3).

Thus, pictorially (as illustrated in Figure 19 below), this may be described as: multinational corporation influencing/dictating to Government to comply its policy. They tend to use threats of arousing public agitation against Government in any attempt to refute the company's demand for absolute monopoly of the local market.

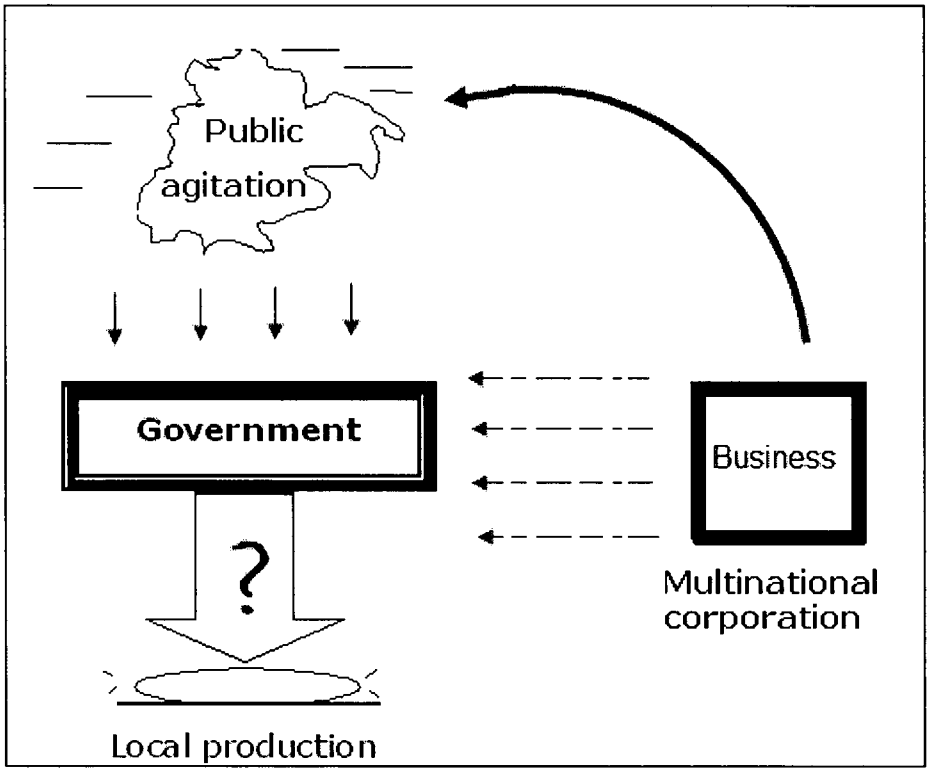


Figure 19: Illustration of the "killing" of the local production system in Ghana (Source: Author)

In such "waves of fear", government, feeling powerless, wittingly or unwittingly kowtows to the demands from the business world of the multinational company and "kills" the local production system in a particular sector, e.g. the just narrated soft-drink production or shea butter production alluded to by respondent as seen in this study. This picture obtained from the views of respondents may require further research using a different methodology. However, in the interim, whichever sector is affected, the concern here is its long term and short term negative impact on the prospects of developing the local technologies for local businesses in the country.

vii. The Ghanaian Attitude to Local Products and Production

Infiltration of manufactured goods from around the world into the Ghanaian local market appears to highly attract the population in general to indulge (Hofstede, 2011) in these products. Sometimes, as gathered from respondents in the fieldwork, the patronisation of foreign goods is for ostentatious reasons rather than necessity. This affinity for foreign products therefore serves as advantage to foreign firms at the expense of local productions. The question however; whether local productions will be able to meet local demands is one that will require further studies elsewhere, and hence, will not be considered here. In the interim, it may suffice to state here that from observations, local productions potentially have great prospects for growth and development if exploited and enhanced.

Coupled with this and some of the features of African society identified earlier, like the late entry of the concept of development and the assertion that African society has rather lost its historic ability to develop its traditional systems, it may be stated here that the production aspiration towards economic growth may require more concerted efforts and attention than the current seemingly passive attitude being displayed.

It was deduced from the shop-owner (respondent having long term experience with customers), that the local market was probably impenetrable by the local entrepreneur competing against world class producers. The attitude of Ghanaians undermining local goods in preference for foreign manufactured products largely contributes to this impenetrability. Further discussion with some Ghanaian locals expressed similar views with one stating;

> *...It isn't that we* [Ghanaians] *do not manufacture anything. What happens in reality is, even when the product is made in Ghana, the manufacturers will write on the packaging that it was made in Korea or Japan or someplace like that. In that way, their items sell faster* (Source: Fieldwork, 2013).

The respondents' statement adds to the claim that the demand for world class manufactured goods in Ghana is attitudinal; this being an ostentatious craving for foreign goods so as to show off. According to the shop owner, they (the Ghanaian customers) are prepared to pay (high price) for them (the foreign products), hence, shop owners see low patronage of locally produced goods, except where there are no alternatives. This suggests that there is no strong desire (impetus) to engage in competitive local production. Possibly, this was what inspired some authors to think of Africa as failing (refusing) to compete (Lall and Pitroballi, 2002) industrially. The Ghanaian society thus shows a docile attitude to local productions, which is reflected in the lack of cohesion and clarity exhibited by the institutions setup to stimulate and promote productions and technical issues, especially technical education. The low level of support in technical matters is so vivid that, according to a respondent, '*...technical education is seen by Ghanaians as if it is meant for those who are blockheads*' (Source: Field note #i5-a2).

It is indicated in Chapters Two and Three of this thesis how various successive governments in Ghana (as in other African countries) have provided incentives geared towards industrialising the economy but failed to stimulate the required growth in the manufacturing sector, thus, failing in its

industrialisation attempts. It is here perceived that the industrialisation agenda did not seem to contain any institutional framework that could identify and promote *local productions* and the manufacture of *local* and *traditional technologies*, eventually leading to higher technologies for the national industrialisation of the economy. The seemingly absence of such a framework could be considered to be due to the same attitudinal reason of undermining technical competence. More so, it suggests that the institutional setups, even if ever prompted, are held back by the attitudinal front as seen in the claim of political interference in their duty as stated by respondents in the case of the soft drink producer previously mentioned.

As a result, some government established institutions are even deviating from their core mandate to different areas which have higher financial reward. An example of such is one cited by a respondent from an engineering establishment, thus;

> *...we are contemplating on developing our training unit and eventually establish a technical university from it. You see, that is where the money is when the students pay their fees; government is not funding us sufficiently so we have to device other means* (Source: Field note # i8).

From the above respondent, it can be seen the establishment which originally in a non-academic institution has been contemplating incorporating an academic component into its setup for its financial gain. Revenue to be generated from the tuition fees becomes the motivating factor. This shift in focus may be seen to further weaken efforts by government at driving

the nation towards its technology creation goal. Here, an attitude of seeking instantaneous financial reward becomes the necessitating factor, but not the long term drive towards creating a technological base for the nation.

Simply put, at the moment (within the limits of this study), the Ghanaian society, from its attitudinal outlook does not seem to appreciably reward technical efforts in production or manufacturing.

viii. Government's Institution and Technology Creation

This section highlights some observed complexities of how officials in a government establishment set up for industry seem to work against the promotion of local production in the country.

A government institution, either set up for or linked to the creation (manufacturing) of [production] technologies for local industry seems to function under circumstances that require caution in their analysis before coming to a conclusion. Faced with global competition mainly from the Chinese and Indian imports, one may assume that the operations of these establishments will be assiduously designed to challenge the foreign competition coming into the country, but this was not found to be exactly the case. Often they were found to operate and deliver their services beyond the comprehensibility and affordability threshold of local producers. A case in point is the local soft drinks producer previously cited (see sub-subsection 6.3.2: vi), this institution tends to work against the local production system as a result of political interference, as previously indicated.

Hence, the established institution, though perceived to be professionally competent, seems to be failing local industries.

Ghana, aspiring to transform its economy industrially, realises the need for a strong technical background to supply the manpower, knowledge and skills required for industrial take off. This led to a number of reformations in education and development policies as indicated in Ghana's development agenda and industrial policy reviews (Government of Ghana, 2010, Ministry-of-Environment-Science-and-Technology, 2010, Republic-of-Ghana, 2011a, United-Nations-Conference-on-Trade-and-Development, 2011). These policy reviews detailed extensive industrialisation intentions and implementations, but seem stalled by what may be described here as limited ground knowledge, a prerequisite to identifying a suitable approach to adopt for the industrialisation agenda. Its emphasis seemed built on a global perspective, somehow not paying much attention to the local production system on the ground.

Some progress, however, could be said to have been achieved by Ghana in terms of declaring the industrial intentions and producing supporting documents like the policy documents, but its impact on the ground is highly confined to the white-collar job operating outside the realms of local industry as observed from fieldwork. There seems to be no compelling force to motivate officials at the government agency to carry out their work uninterrupted for a successful implementation and take-off of an industrial development agenda. As indicated by a respondent, they are unable to execute professional decisions due to external political interference on their work. For example, according to the respondent;

> *A lot of times, people do not comply with the requirements set in place and whenever we want to take a decision against them, these politicians come and talk pl-e-e-e-nty* (plenty) *and at the end, we can't do anything. I am fed up with them. They don't allow us to do our work; they allow all kinds of things to be brought into the country from China and Dubai ...but we have no strength to enforce the policy we have* (Source: Field note #7-5).

According to the respondent, it is suggested that government employees at this agency are demotivated by delimiting their professional prowess by politicians. Since it is government that pays their salaries it appears their work output is measured by compliance to government officials' directives and not based on their professional decisions and work ethics. The officials, therefore, seem powerless, and hence, compelled to override their core responsibility due to the external pressures as indicated by the above respondent. Thus; the failure (or success) of a project, while not a direct fault of theirs, is no danger to their livelihood as they are not given the trust and freedom to exercise their professional competence. In such a case, it may be argued that there is no impetus to see to the success of a specific project's implementation in Ghana. Though the officials may work assiduously, that inner drive of an entrepreneur for successful output (reward based on output) appears to be absent.

It is therefore suggested here that government efforts at creating technology for local industry is consistently being held back by a complex network of forces not within the controls of a specific domain or agency, as government employees are here

seen to be rendered ineffective in carrying out their core duties without undue interferences.

ix. Ghana's New Strategic Approach to Technology Development

Following the challenges engendered by its unsuccessful industrialisation agenda, Ghana, according to a policy maker as respondent, has adopted a new approach based on preparing the workforce from the educational sector. The ensuing narrative establishes the account as obtained from a respondent, suggesting the new Ghana approach to industrialisation is inclined towards meeting the manpower needs of anticipated investors rather than on 'home' technology creation.

In relation to considering the manufacturing of technology for local industries as a central focus for technology development in Ghana, Government, through the academic institutions, adopt a *strategic* approach in supplying the knowledge and skills required by the workforce of the industry. This can be deduced from the respondent, thus;

> *So if you look at it very critically, they* (i.e. the university and polytechnic engineering programmes of study) *are strategic; strategic in the sense that, they can operate relative to the courses that are in the programmes. So somebody who has studied chemical engineering can also work in a manufacturing company which has something to do with an aspect of the programme that he studied...* (Source: Field note # i3-a3).

According to the respondent, the absence of a Ghana industrial base called for such strategic approach to be adopted so that the skills required by a foreign industry will be available when one such investor comes up. Respondent continues and brings to the fore, how there are no more Ghana industries, that the industries have all collapsed. In his own words, he states:

> *...the problem is that most of our industries have collapsed, so, as a result, initially that plan that we have for industry per say are not there and that makes it strategic* (Source: Field note # i3-a3).

The strategic approach therefore meant that courses relevant to industry are taught, at least, at the first degree at the polytechnics and universities. Some of these courses in engineering include; production engineering, plant engineering, mechanical engineering, electrical, civil, construction engineering, material selection and metallurgy, excluding the sciences and applied sciences. These courses could here be described as derivative courses to manufacturing engineering, as manufacturing, in this study, is argued to be central and fundamental to making the tools and equipment used in all professions including the courses (see Chapter 4 of this thesis). It can be observed, manufacturing engineering is not included in the list of curses shown.

The centrality of manufacturing, as is the position in this study was however challenged by a respondent, who in his view, perceived it as rather the outcome of other fields of engineering. Thus, while conceding manufacturing as central, he argues that it should rather be seen as the derivative of other fields of engineering and not other fields being derivative of

manufacturing. His position simply further demonstrates the prevailing mindset in Ghana where manufacturing engineering is not accorded its due significance. This is evident in the fact that, as at the time of writing this thesis, no academic tertiary institution offered a manufacturing engineering programme, at least, at the first degree. Contrary to respondent's position, this study argues from the perspective that, before all other professions could function, they will need to work with certain tools, specific to a task depending on the nature of their work. These could range from simple tools as pen and paper, hammer and chisel, etc., to sophisticated machines like the personal computer, medical equipment, etc., and all these have to be manufactured for effective work performance. So in effect, manufacturing remains central to all and could be argued to be equally fundamental to the operations of all professions as well. This, however, depends on one's view point. And the view point could be an indication of how much relevance it receives.

As noted in this study, none of the government established tertiary academic institutions in Ghana offered courses in manufacturing engineering. Their strategic plans seem to be focused only on the courses described here as derivative, a means to supply a competent workforce to industry, excluding manufacturing (or the act of manufacturing). Its approach is in the hope that some manufacturing investors will come into the country to setup the industry which will require the trained skills available. This was deduced from a policy maker respondent, thus;

> *...if we get investors from the manufacturing sector, say, if a manufacturing firm chooses to come and set*

up its manufacturing business here in Ghana, then, that will help. Government is doing all it can to attract foreign investors into the country (Source: Field note #13-4).

This therefore presupposes that the policy's emphasis is not on stimulating manufacturing locally, but to provide a base, i.e. the needed workforce to meet the demands of anticipated investors.

The absence of the study of manufacturing engineering in the Ghanaian curricula is seen to reflect in the formal sector of administrative and legislative setup in the country. For example, as at the time of writing this report, as deduced from respondents, an automobile manufactured in Ghana could not be registered in the country, it necessarily had to be imported (Source: Field note #8-4 and #9-1; refer to Appendix Two). This strengthens an earlier presumption that Ghanaian institutions lack the drive towards self-initiative in manufacturing, though the need for it is recognised.

It may be observed here that the Ghanaian perspective to technology creation (manufacturing) is understood differently; as it is expected to come from outside of the Ghanaian society by being brought in. The Ghana medium-term development agenda (Government of Ghana, 2010) and the industrialisation policy (The-Republic-of-Ghana, 2011) portray similar stance. This is opposed to the position of this study, which seeks an approach whereby manufacturing becomes an outcome of the society (locally initiated, culturally assimilated, evolving and owned by the society). The Ghanaian concept of manufacturing leaves much to be desired and may require further consideration by academicians, government officials and policy makers to situate

its relevance and confidence within the Ghanaian development structure.

This writer, while interacting with some policy makers and executives of Government Departments in the course of this study discovered that they were vague on which institution best addressed manufacturing concerns in Ghana. For example, some of them identified different institutions, such as the Association of Ghana Industry (AGI), Ghana Standards Board, Council for Scientific and Industrial Research (CSIR), Institute for Industrial Research and GRATIS Foundation (to be discussed further in the subsequent Chapter 7) as being mandated for technology creation in the country. Some of these aforementioned institutions, on the contrary, point to other setups, like academic institutions, to come up with required technological solutions. Take for example, a respondent's statement from one of such institutions;

> *...we make efforts to address the technology needs of our members through the universities. We signed an MoU* (memorandum of understanding) *with Kwame Nkrumah University of Science and Technology* (KNUST) *in 2006 to collaborate with industry to develop appropriate technologies for local manufacturers* (Source: Field note #i4-a6).

Academic institutions are expected to assume the role to develop technologies for local manufacturers, while the academic institutions, focusing on teaching and research in a broad sense, refer the technology creation responsibility back to those looking up to them, stating, 'the universities, as much as possible, are not commercial centres' (Source: Field note #i3-a1), thus,

implying academic institutions should not be seen as a technology production centres, but have their core function in academia.

The lack of clarity on the role of specific institutions to address the technological needs of local production industry also suggests a situation of a lack of coordination and non-coherence among decision makers in technology development.

Institutional designation for the creation and deployment of manufacturing and production technologies for local industries, though somewhat prescribed in a number of government agencies such as GRATIS Foundation, Institute of Industrial Research, Ghana Standards Board and others, remains vague leaving entrepreneurs to source for their technological needs abroad. Respondents representing the local industry (i.e. SMEs) claim to still rely on importation of all its production machineries. What is obvious is that there seems to be no concerted effort to focus attention on meeting the technological needs of business through manufacturing in Ghana.

A misconception seems apparent within the Ghanaian society as academic and other institutions are being blamed for the failure to provide pervasive technical solutions to the country's local industry. Take for instance a respondent's comment;

> *I don't know what our universities are doing; our engineers there can't do anything. We don't even make bicycle tyre in Ghana* (Source: Field note #9-3).

Such assertion points to the probable confusion (non-cohesion) identified earlier in the wider society including academicians, policy makers and government officials on the roles of the

various institutions with specific regards to manufacturing of production technologies in Ghana.

x. Nationwide Manufacturing Setup in Ghana

It was gratifyingly identified in this study that, there are nationwide manufacturing centres in Ghana. They could have been seen as part of a strategic approach, though not mentioned as one. This, implying, it is probably not of so much intention or significance. Indeed, the optimal potentiality of these setups seems obscured by a mix of factors not clearly understood here, but which apparently stems mainly from (according to the perception of this study) the absence of cultural assimilation of the manufacturing concept in the Ghanaian society. This is found to permeate into the governmental setting, thus, leading to the dwindling manufacturing culture. More so, the setup does not appear to possess a local initiative. It seems strongly rooted (dependent) on foreign initiative and funding as shown by the following narrative.

According to respondent (Source: Field note # i8-a21), Ghana government, with assistance from the European Union, the Japanese government and other donor agencies, has set up the nationwide manufacturing units. These setups (henceforth referred to as the unit), are seen as the potential bedrock for local manufacturing of production/manufacturing technologies for both local industries and multinational corporations operating in Ghana.

The effectiveness of the unit in meeting the demands of local industries however leaves much to be desired. For example, its revised mission statement, as obtained from respondent, aims to:

research, design, develop and manufacture, at the same time engage in marketing the end product of the technology from local enterprises. The unit, in the context of this study, is over laden with a broad scope of tasks in its mission. More so, it is perceived not to be significantly lucrative, as the revenue generated is not sufficient to cater for staff salaries; Government therefore pays its staff salaries and continues to provide funds to keep it running (Source: Field note #i8-a8). The fact that it is not successful to even cater for itself casts doubt on its viability and the practicality of its mission statement.

This may therefore imply that, though the unit claims to provide a high degree of engineering and technical services, it does not, however, generate appreciable funds by itself that should justify its relevance to government, or rather, to strongly establish itself in the Ghanaian society. Take for example a respondent's comment;

> *In fact, the Government of Ghana doesn't see the relevance of* [the unit] *in its industrial development* (Source: Field note #i8-a6).

The relevance of the unit to government and the Ghanaian society in general needs to be more accentuated otherwise, it may never be of much significance. In fact, it was noted that the affordability of its product range was often beyond the reach of the [Ghanaian] local industry. The multinational corporations, on the other hand, come as regular customers for its services and make prompt payment, as indicated by respondent.

Some of the range of products from the unit consists mainly of heavy metal works such as waste containers, agri/agro

processors like graters, kneaders, etc. for the rural industries and local producers in general. The unit, however, relies a lot more on non-governmental organisations (NGOs) and government departments to place orders for the manufacture of these equipment and machines. The local producers and indeed, the local industry, in this case, including the SMEs, are not able to afford their machines. As a result, the SMEs continue to rely on the importation of machines, as noted by respondent (Source: Field note # i14-a4).

The high prices of machineries from the unit suggests its operations are not competitive enough compared to foreign imports from such places as China and India. The seeming inability to compete seems to have led the unit to consider diversifying its operations to rather develop its training section into a main stream academic institution of learning and research as envisaged by its authorities. The intention to diversify further points to the vagueness identified in its broad mission statement thus, suggesting a weak base.

Strengthening its training (education) unit is not in this instance critiqued on the basis of irrelevance, but the gradual shifting away from the already not very clear mandate. This is seen as possibly further endangering the prospects of any solid vision towards the manufacturing of technology in the country for local industry. The unit, in attempting to achieve much seems to lead to a level of inconsistency in objectives. In this case, it may be said that the unit could probably benefit more from a restructuring of its mission to achieve the mandate of its vision of providing technological excellence to all Africa. At the time of writing, it holds a great advantage as being represented

throughout the country and could become the most effective medium for technical deployment. This advantage is yet to be fully exploited.

6.4 Case Study of Shea Butter Production in Ghana

As earlier mentioned in this chapter, the study will consider a case study of the shea butter industry. This section will therefore focus on the direction of travel of the industry in the context of technology requirements for its production processes. The discussion will assess the attitude and approach taken by those in authority as they make decisions for the industry. Its value-addition prospects are also of much interest in this section. Thus, this section seeks to provide a brief account of the convolutions surrounding the provision (manufacturing) of technology for the *local production* in the industry.

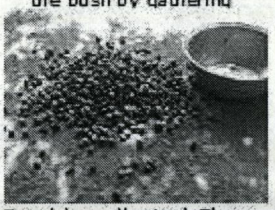
The narrative developed here shows how shea butter production in Ghana, using the traditional methods of extraction, is less efficient, crude, time-consuming and non-profitable, while at the same time, not much attention has been given to meeting its technological needs. This case study hopes to highlight some salient features of the shea butter industry. The aim here is to raise substantive issues for discussion in the narrative to help shape the construction of a technology development framework for national and local industries.

6.4.1 Traditional Method for Shea Butter Production in Pictures

This sub-Subsection is an attempt to pictorially present, in an order of sequence, the traditional method of shea butter production in Ghana. The Figure 20 (a-i) below provides the pictures for the process little caption notes attached to the pictures.

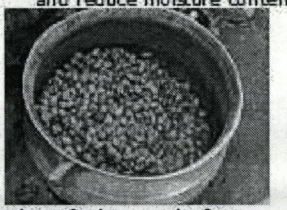
The following steps (in order of numbering) is the process used for making Shea butter. This process was found to be common knowledge

1. Collect Shea fruit from the bush by gathering



Freshly collected Shea fruits

2. Boil the fruit to cook the nut and reduce moisture content



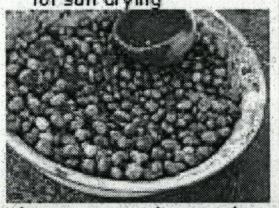
Shea fruits ready for boiling

3. Boil using hard firewood for long period, clean fruit to reveal the shells

Collected fruits boiled overnight

a

4. Spread out cleaned shell for sun drying



Shea nuts to be made dried

5. Dried nuts are either stored with shells or as kernel

Dried nuts are collected on rooftop called "garu"

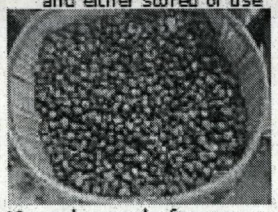
6. The nuts are beaten with stick to break shells to remove kernel

Picture not available

Kernels are separated from shells, further dried and used or stored

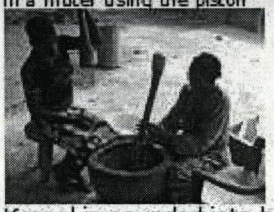
b

7. Further dry the kernels and either stored or use



Kernels ready for use

8. Crush the dry kernels into bits in a muter using the piston

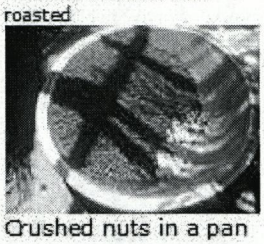


Kernel is pounded into bits

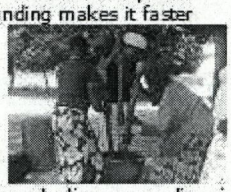
9.

Crushed kernel in a muter

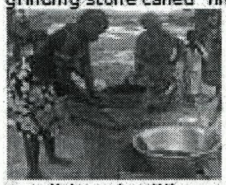
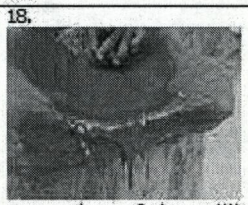
c

10.Remove crushed nuts from the muter to be roasted  Crushed nuts in a pan	11. Roast the crushed nuts by heating and continuous stirring in the pot  Roasting over open heat	12.Roast until it turns into paste; sign of the oil in the butter  Crushed nuts turns into paste

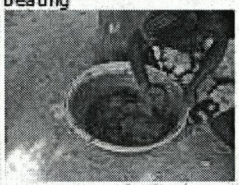
d

13.Further pound the crushed roasted nuts into paste  Three pistons pounding	14.More than one person pounding makes it faster  Three ladies pounding in a muter	15.Pound until it turns very wet  Pounded nuts now flows

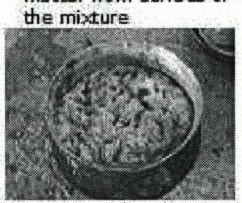
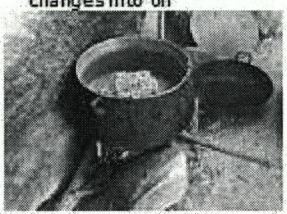
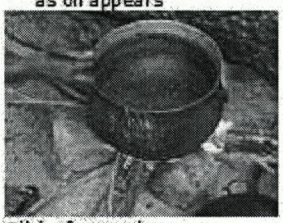
e

16.Scoop out paste from muter into container  Scooping out for milling	17.Mill into fine paste using the grinding stone called "nierr"  Traditional milling setup	18.  Operation of the milling stone

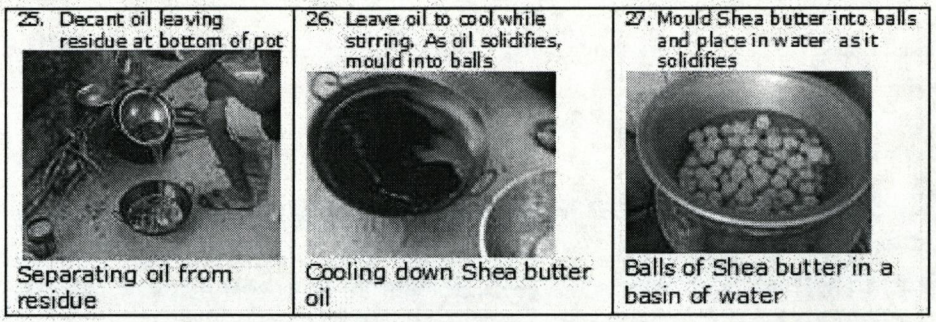
f

19.Continuous mixing and beating of paste to separate the fat  Mixing and beating paste	20.Mix and beat until surface of past turns oily, add warm water and continue mixing and beating  Presence of oil shows on paste	21.Paste turns whitish, increase mixing action adding cold water  Butter forms, ready to separate

g

22. Collect the whitish matter from surface of the mixture  Fat removed to be boiled	23. Heat until substance changes into oil  Hating to produce oil	24. Keep stirring intermittently as oil appears  Oil is formed

h



i

Figure 20: (a-i) Pictorial representation of the traditional method of Shea butter extraction in Ghana (Source: Author)

In the above demonstration, five women were involved in the shea butter extraction. The whole process, from step 7 (from the above Figure 20 (c-i)) to the last stage of obtaining the oil in step 26, took a total of sixteen hours to complete. It was a laborious and time consuming process.

Seeing the difficulty in the traditional production methods and the craving by the traditional producers to substitute their labour with the use of technology, it, this study takes the interest to make comparisons. The comparison here is between the traditional production method and the use of existing technologies (machines) employed in the production process. The following section presents the comparison.

6.4.2 Traditional versus Mechanised Shea Butter Production

Shea butter is extracted from shea nuts of the shea tree. The nuts are obtained from the shea fruits which are collected by women freely from the wild mainly in Northern Ghana and from other parts of the country like the Volta Region. The sales and export of the nut has attracted government attention since the

colonial era and has thus been placed under the control of different government parastatals over the decades (Chalfin, 1996). Despite its long history, the shea industry is still technologically very rudimentary. The nuts collection from the bush and its process of extraction, usually in a family setting involves kitchen-like activities. It is predominantly seen as the woman's job as indicated by respondents. According to respondents, it was forbidden for men to participate in any stage of its production process as can be seen in her statement, thus;

> *...in the past, men were forbidden and not allowed to touch any item used in the shea butter preparation or touch any part of the process. It was a taboo; if they did, the process was believed to have been defiled and it will have to go through a purification process...* (Source: Field note - #4-42).

Albeit being a woman's job, researcher was nevertheless allowed to observe the complete butter extraction process as carried out by the women respondents. This writer can confirm that this was found in exact sequence as narrated by Carette et al., (2009). According to the authors, and as described by respondents in this study, shown in Figure 19 (a-i), the process begins with the nuts (also called Karite nuts karite butter for the butter) obtained from the shea fruit; the fruits are firstly fermented to remove the outer fruity component to reveal the shell. It is then cracked to obtain the kernel, which is then dried, ground into paste and processed into the butter. There are two known varieties of the nut, the Vitellaria paradoxa (formally called Butyrospermum paradoxa) and Vitellaria nilotica, all of which grow wild, none

cultivated and are all native to African soil, stretching from West, through to Central to East Africa (ibid).

The work of Carette, et al. (2009) provides extensive account of shea nut and butter production and trade in Ghana. The authors revealed that most of the nuts collected were exported rather than processed into butter or any derivative product. The main constraint, according to the local producers, was being able to find buyers for the butter and a lack of government support. Further investigations by the authors showed that inconsistency in shea butter quality from the traditional production method was a major factor negatively affecting its export prospects, hence, buyers' preference for the nuts rather than the locally processed butter.

There are however efforts to improve the production methods through some form of mechanisation, where, often time, existing regular milling or attrition and kneading machines are used for certain stages in the production process. This brings to the fore a twofold method of extraction, i.e. the traditional (manual process) and the mechanised processing (Issahaku et al., 2011). When comparing the two methods, Carette and her colleagues found that the savings gained by using the more efficient mechanised process was offset by the running cost of high price of diesel and electricity involved in operating the machines, thus, making the traditional manual production method more profitable even though it is less attractive, time consuming, laborious and tedious.

Thus, the current mechanised method does not offer any profitable advantage over the traditional production method. This therefore implies that further study into the operations of the

production process may be required to find a more profitable method for the shea butter extraction. The technologies required for the shea butter processing will need to be designed for purpose and not just adapt or modify existing machines for it. This finding further accentuates the relevance of this subject matter for technology manufacturing.

6.4.3 Ghana's Approach to Developing the Shea Industry

The economic potentials of the shea nut/butter industry as a viable source of national income could be described as having been duly recognised. It has attracted the attention of government since the colonial era. This is reflected in the attention it has received over the period, one of which includes the establishment of a sub-station of the Cocoa Research Institute of Ghana (CRIG) in 1976 in the Northern town of Bole, by the then Ghana Cocoa Marketing Board (GCMB) (called Cocobod for short) as its subsidiary (Horizon-Solutions-Site, 2002).

Cocobod, which has been given mandate over the shea industry, has not been keen in defending the interest of the produce to the highest degree. For example, Cocobod was found to lobby against the shea butter/nuts marketing prospects (Chalfin, 1996). Indeed, it has been noted that 'Ghana has worked against expanding the shea market' (ibid, pg. 440). This obstruction invariably comes from for Cocobod, being principally designated as responsible for the cocoa industry, invariably treating the shea industry as secondary to its core mandate of marketing cocoa. It is therefore postulated that Cocobod will not give the

utmost consideration and/or assistance for the optimal performance of the shea market. This probably explains why the Civil Society Organisations (CSOs) of Northern Ghana have demanded a clear policy review on shea nut produce with calls for greater autonomy (Northern-Ghana, 2008). There is a call to dissociate the shea nut industry from Cocobod in the belief that its autonomy will provide more opportunities for its progress (ibid). The interest in this study however is whether the shea industry is treated as primary produce or value will be added to it. Taking a closer look at the steps taken by the overseeing authorities and politicians may provide a clue to its direction in terms of value-addition.

The first major step taken by the Cocobod authorities towards the shea industry was to initiate research into reducing the gestation period from between fifteen to twenty years to between three to six years according the CRIG (Ghana-News-Agency, 2010, Issahaku et al., 2011). Further accomplishments were the establishment of a number of shea butter factories, with some receiving very high profile attention, for example, one being commissioned by the then Vice President of the country (Issahaku et al., 2011, Ghana-News-Agency, 2009, Ghana-Government-Official-Website, 2009, Daily-Guide-Business-&-Finance, 2008).

These may be attested to as significant progress achieved in the industry, although this study found that no focus was given to the manufacturing of the technologies required by the industry to add value to its natural produce. Indeed, the question is whether the gestation research was really of such necessity at this stage of the industry given the abundance of the shea tree

and its nativity to the African region. It being native does not merit the urgency in treatment for adaptation to local conditions and its abundance does not warrant the gestation reduction research as a priority. This can be contrasted with cocoa which was introduced into the country (Ghana-Cocoa-Board, n.d.-a) and adopted by the local farmers (Acemoglu and Robinson, 2010), and hence, requires much attention to preserve its growth and productivity.

It has been observed in this study that the same approach accorded the cocoa tree, in terms of researching into its disease control and yield, was simply transferred to the shea tree. In reality, the shea nut is widespread with current yield far exceeding demand (Carette et al., 2009). The position taken by the authorities as the first step to invest in research into its yield and gestation could thus be deemed as a misplaced priority, for reasons already alluded to earlier. Instead of investing in developing technologies for its value-addition, the decision was rather taken to invest in increasing its yield, which already abounds and exported as a primary produce.

There seems to be an avoidance of the engineering component required in the value-addition process. The engineering component here would have led to developing specialised technologies specifically designed and manufactured for the shea industry. These technologies would normally be designed with higher capability in output efficiency and, would invariably eliminate the downside of the currently adopted mechanisation process in use that has proved to be unprofitable. The seemingly avoidance of the engineering component is suggestive of the Ghanaian attitude towards manufacturing.

The deliberate or unconscious engineering avoidance may be due to the absence of a strong manufacturing base in Ghana to be relied upon to come up with product varieties. Recall that this absence of a strong technological base is prevalent in all nations of African origin throughout the world. This makes this study even more relevant for the continent, and hence, Ghana, as an African nation needs to find an appropriate means for its technology. The modern Ghanaian system is, however, not found to have sought any new and appropriate ways to maximise the benefits of the industry. This further strengthens the argument that there is neglect by the formal sector (government) in developing the traditional technology for local productions. In fact, from what has been observed so far, it is conceded that there are as yet no deliberate efforts from the Ghana leadership to see to the technological needs of the local businesses engaged in traditional productions. Take for example a respondent's assertion;

> *Ghana has lost the triangle of development; it is absent in Ghana. Development is a triangle like this* (respondent draws a diagram (see Figure 21) to illustrate). *It is a triangle with Government at the top; it should be receiving directions from research institutions for the benefit of the people.... Government needs to involve the people in policy making, but it does not do so* (Source: Field note #6-1).

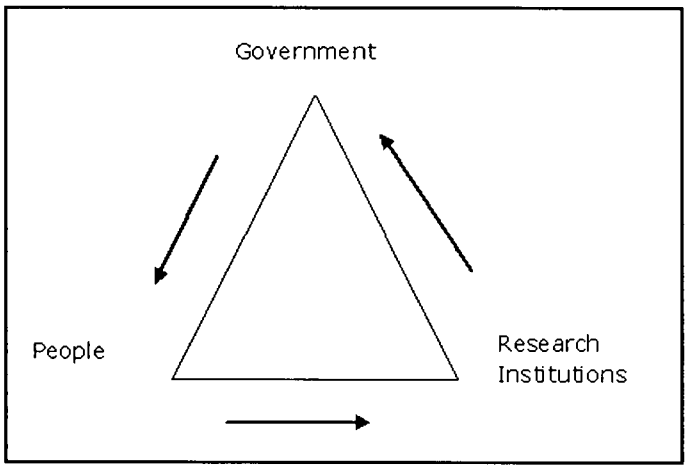


Figure 21: A national development triangle (Source: Fieldwork; respondent's opinion)

Respondent's observation of government not consulting seems applicable here in the shea industry. There seemed to have been no balanced consultation made in this respect.

6.4.4 Shea Butter Industrialisation in Ghana

While the increase in popularity of the shea crop has attracted attention leading to the establishment of factories for the extraction of its butter, it has been received with a measure of dissatisfaction. This is because it appears to be a repeat of the old approach of relying on importation of technical solutions. Take for example the $10m shea nut factory built at Buipe and inaugurated by the then Vice President (Ghana-News-Agency, 2009). According to the Ghana News Agency, the factory was a joint venture between Ghana (Produce Buying Company Limited (PBC)) and Brazil (Messrs LDS Maquinas e' Equipmentos Industrias Limited) (ibid). The venture suggests Ghana most probably relying on Brazil for the required technology or, at least the funding, for the factory. Again, it can be seen here, Ghana is absenting itself from any attempt to manufacture, at least, some

of its technologies; it is relying on Brazil for the provision of the technologies.

Again government approach seems to point to the avoidance (or a lack confidence) in building the engineering capability of the nation's citizenry for technology creation and its development.

This apparent lack of confidence as well as the lack of emphasis on manufacturing of technology seems to be historical, endemic and chronic in the Ghanaian society and such; a development framework with generic applicability is desired and proposed in the next chapter.

6.5 Chapter Summary

In summary, using a mixed research methodology, this chapter, has been concerned with reporting the ethnographic fieldwork undertaken in Ghana. Constructing the narratives emerging from the fieldwork, this study used the Straussian version of grounded theory (Corbin and Strauss, 2008) for the construction and analyses of its findings. Among other things in the finding, the narrative identified and distinguished between *traditional production* and *local production systems* as two distinct forms of production systems worth noting, different from small-to-medium enterprises (SMEs). The production systems identified served as a yardstick for the analysis and extent of technology underdevelopment in Ghana. It also highlighted the complications of institutional failures and bureaucratic processes in the Ghanaian formal sector as it affects the local production system.

The entrepreneurs engaged in local production, in addition to the complication of the state bureaucratic structures, were found to face the challenge of having to compete with "powerful" multinational corporations which capitalise on Ghanaians' affinity for manufactured goods to influence government. This affinity empowered them against local producers. As such, government's efforts towards production are hampered by its alliances with multinational corporations in addition to a lack of clarity among government officials on its institutional operations in line with technology creation.

The academic institutions in their contributory efforts to technology development employ a strategic approach in the education and training of a prospective workforce for industry. Their efforts do not seem directed at local industry and has little or no linkage of student projects to industry. The education curricula, at the time of writing this thesis, lacked a manufacturing engineering course, even though the tertiary academic institutions were assumed by other government institutions and the society at large to take on the role to manufacture technologies for local industries. It was also found that officials at some government agencies visited lacked incentives and the freedom to carry out their professional duties without interference by government and politicians.

A case study of shea butter production was undertaken. Shea butter production in Ghana was found to command national attention, but developing the industry was found not to have changed in approach from conventional practice used by Ghana Cocoa Board (Cocobod) to manage the cocoa industry; it remains a primary produce with not much effort made to add

value to it. The engineering capability to create its needed technologies for value-addition seemed highly neglected. It has therefore become necessary for an alternative approach to be developed by which Ghana could improve on its traditional technologies to become more efficient and competitive.

6.5.1 Summary of Findings

In summary the major findings of the thesis as elaborated in the above narratives are provided in the itemised list below.

- The Ghanaian society was found to be culturally rich in traditional (indigenous) technologies, but they have never been improved, hence, left at their rudimentary state all through history.
- Ethnic and cultural divisions found in traditional Ghana seem to adversely impact on cultural exchange. This is suggested to inhibit knowledge sharing and transfer, which invariably impedes the prospects of growth traditional technology.
- The whole concept of development was found to be a relatively new occurrence to the Ghanaian cultural society (informal sector). This probably explains the vague attitude found among the professional group, including policy makers in Ghana towards the issue of technology development.
- No policy or framework was found in Ghana for the creation of technology for the local production industry.

- Technical education was found not to be esteemed in Ghana. It is indeed, significantly undermined, attracting less than 2% of the educational budget.

- No tertiary institution offered a course in manufacturing engineering, at least, at the first degree.

- Operations of some government agencies and institutions were found to work against local productions with their bureaucratic procedures and political interferences.

- A case study of the shea butter industry in Ghana pointed to a fatalistic feature in the Ghanaian society among the decision makers towards technology for the industry.

- There was no display of intentions to address the provision of production technologies for the local industry.

- Politician meddling in the of work expertise at government agencies.

- Government institutions not geared towards promoting local production.

6.5.2 Concluding Remarks on Findings

Inferences and deductions made from the above narrative of findings and its summary show that Africa, as in Ghana, lacks a strong domestic technology base and has not been successful in its national industrialisation efforts. In view of this thesis, the pending failure has been attributed mainly to the societal neglect to incorporate and develop traditional technologies into mainstream modern technological solutions. This neglect has denied the Ghanaian society from assimilating modern

technologies for ownership and development, thus, the traditional technologies have remained rudimentary throughout history.

In a concluding statement, it may be said here that Ghana, as a society, has not demonstrated the ability to, out of a self-initiative, develop its own technology base. This is not to say the Ghanaian society lacks the technical prowess to create a technological system for development, the motivation to maintain such a springboard can be said to be lacking. This is demonstrated in the cases of Ghana and Nigeria, who were able to manufacture technologies to serve the periods of hardship and battle respectively, but this prowess soon died out when the compelling situations were no longer being confronted.

It may therefore be concluded here that for Ghana to develop its technological capabilities in a consistent manner for national economic growth and development, there is the need create a stimulus to serve as the driver and motivator to such feat. This stimulus, in the perspective of this thesis, should not be imported, but should evolve from the cultural backdrop of the Ghanaian society itself. In this way, it becomes the product of the society, thus, its future performance and development, will dependent on the cultural instincts of the prevailing society with each impacting on each other to shape its eventual evolution of self-ownership.

CHAPTER SEVEN

7.0 BUILDING THE GHANA MANUFACTURING OF TECHNOLOGY MODEL (GMTM)

7.1 Introduction

This chapter focuses mainly on constructing the Ghana Manufacturing of Technology Model (GMTM) called, the Model, for short. The Model is for the manufacturing of production and/or manufacturing technologies in Ghana. The work of Sagasti (1992) was used as the framework for its construction and the Findings (see Chapter Six of this thesis) from fieldwork and literature review (provided in Chapters Two, Three and Four of this thesis) provided the contents for components of the model. Identifying the right components helped streamline the Model into resonance with the natural cultural "rhythm" (Clemens and Dalrymple, 2005) of the Ghanaian society, thus, entrainment (ibid).

The model is to stand as a government institution, set up to stimulate the manufacturing of technologies in the country for the local industry. A governmental institution as this is needed to stimulate the technology development agenda in the country. As noted from the findings, the traditional and modern Ghanaian society has not been able to display a self-initiative towards improving or developing its processes or artefacts of production, thus, leaving the traditional production methods still highly undeveloped. This therefore calls for great involvement.

The manufacturing model hopes to address the difficulties that account for Ghana's failures in its efforts to industrialise the national economy since gaining independence in 1957. The model, creating its own institution, in addition to working with established governmental institutions, hopes to:

1. cut across all cultural, ethnic, political and social barriers;

2. push internal mechanisms like governmental agencies, local production enterprises, government policy machinations, etc. to focus on "home" technology building;

3. provide a medium of flow whereby results from academic and research institutions will be utilised in manufacturing to solve societal material problems;

4. create a platform where producers are assured of a constant market for their products once they meet the quality requirement.

The Model conforms to the overarching methodology approach (which utilises familiar projects or concepts to implement new ideas for societal and cultural acceptability, as envisaged for this study and outlined in see Section 1.6 of this thesis in a simplified approach), by *entraining* its core operations to be in consonance with prevailing cultures. The methodology formed the overall principle on which the Model was drawn. It is therefore anticipated that it will be assimilated into the fabric and structure of the Ghanaian society and find applicability in similar developing countries like Ghana, or modified to suit others as need be.

Before getting into details of the Model construction, it may be helpful to look briefly at Sagasti's (1992) work highlighting certain salient components.

7.2 A Theoretical Framework towards Technology Planning in a Developing Economy Context

Planning is a necessary futuristic determining factor in a development agenda. Every [minor or major] project is pre-proposed and eventually executed by the act of planning carried out formally or informally, consciously or unconsciously. Indeed, the act of planning cuts across all fields of studies, especially in the areas where it is most suitable to a particular speciality or section of a profession. As such; it has a 'lopsided application' (Hudson et al., 1979) in a broad perspective.

In many human challenges and endeavours, 'effective solutions require diverse perspectives and multiple levels of action (ibid), thus, its wide exploration in this study. According to the authors, planning covers too much territory to be mapped with clear boundaries, it can however, be identified as the basic principle that underlies all purposeful action. By this therefore, though several approaches to planning exist, there is no single approach that can be said to be perfect for any specific application. The need for analytical choice is inevitable. Planning therefore has to evolve continuously as new aspects of needs emerge.

Thus, in considering a development path, say, technology development (technology creation, deployment, and improvement), it could be seen as constituting a major project.

The composition here may not necessarily of a material sort, but analytical, conceptual, cultural, education, etc., thus, planning becomes an inevitable integral part of the process. Howbeit, it has hardly been applied either from sociological perspective (Portes, 1976) or general corpus of development discourse for technology generation and enhancement in deprived society.

Indeed, it has been difficult, within the limits of this study to find recent publications on planning theories, suggesting that, the subject has been dormant for an extensive period though its application to vast fields of study is extremely vital. A review of development theories within the general context of planning theories has therefore become necessary, as developing nations seeking to break away from the tag of underdevelopment need to actually work out a workable approach, rather than seeking directions (taking instructions) from the already advanced societies. As put by the author Portes, (1976), nations oriented toward development should explicitly abandon the model offered by already advanced societies, implying working out their own model. This, however, should be guided by past knowledge and experience. With caution taken, this past knowledge and experience should be streamlined to... and shaped (re-shaped) by the context of the developing society so as to establish a sense of ownership. That is to say, it should be guided by the knowledge of the principles in the familiarity with the internal problems of "peripheral" [developing] societies and the external constraints under which they must survive (ibid).

Working from such familiarity background of scholars, this study, though not fundamentally a course in the planning subject, will explore its new approaches and criteria, as shown by Dr.

Francsico R. Sagasti, a onetime Head of Strategic Planning and Director for Planning at the World Bank. His work, new approaches to development planning (Sagasti, 1992), would be used as a framework to propose a new approach to Ghana's technology creation and development plan. Owing however to the broad scope, long neglect (as identified in this study) and varying perspectives within planning theories, its extensive review will be deferred for further discussion to a separate study. Thus, the work of Sagasti will be employed as a guiding structure to identify relevant body-types (institutions) as major actors. This will lead to a mechanism of automatic but non-catalytic strengthening of institutional linkages, created within the organisation (makeup) of the Ghanaian social and cultural definition.

7.2.1 The New Approach in Development Planning Theories to Apply to Technology Development in a Developing Society

A truism of human nature is to be productive and develop. Development approaches fundamentally require planning as shown by the work of Portes (1976), however, reasons why some planning theories are more applicable and successful in certain cases (Hudson et al., 1979, Lawrence, 2000) depends on peculiar situations on the ground (local content). Such situations may include geographical, cultural, etc. In that line of reasoning, it may be said that different outcomes in planning could be attributed to varying factors surrounding the understanding of the immediate environment, which invariably influences the implementation mechanism. The surrounding

environmental/societal factors in developing countries could be used as the yardstick for the application of the theories.

This study, aiming to contribute to worldwide efforts at finding lasting solutions to the problem of poverty (underdevelopment) in Africa seeks to do so by looking at how the necessary technologies required for local industries to add value to their primary produce can be manufactured. Following this narrow path of definition to development approach, it is argued that the local content industry would be able to feed the wider economy with its 'anticipatory' outcome of the theory application in a non-static manner, but a continuous motion of development approach leading to a new concept in development planning theories (Sagasti, 1992). Planning, which is a fundamental requirement to this may be inundated with ideas and approaches; hence the emphasis on such narrow focus. It may here be characterised by the ability to identify the niche (Geels, 2004) approach for operation by the concerned society, in this case, modern and traditional Ghanaian society, which is a typical victim of previous failures of traditional planning methods.

In his work, Sagasti (1992) presents extensive discussion on the elements of an *institutional network for national development planning* (see Figure 22) giving their descriptions and functions. In a summary, the structure for development planning will be an "evolving network"; noting that, planning works towards the future, which rapidly becomes the present and passes away into the past (Sagasti, 1992). This evolving network will need to respond rapidly to change in an anticipatory framework, hence, the need for its dynamism. This invariably implies that it should be flexible, open and capable of restructuring itself over time

(ibid). The network would essentially need to operate as 'an interactive and decentralised system, using cognition and compromise' in decision making for dealing with issues.

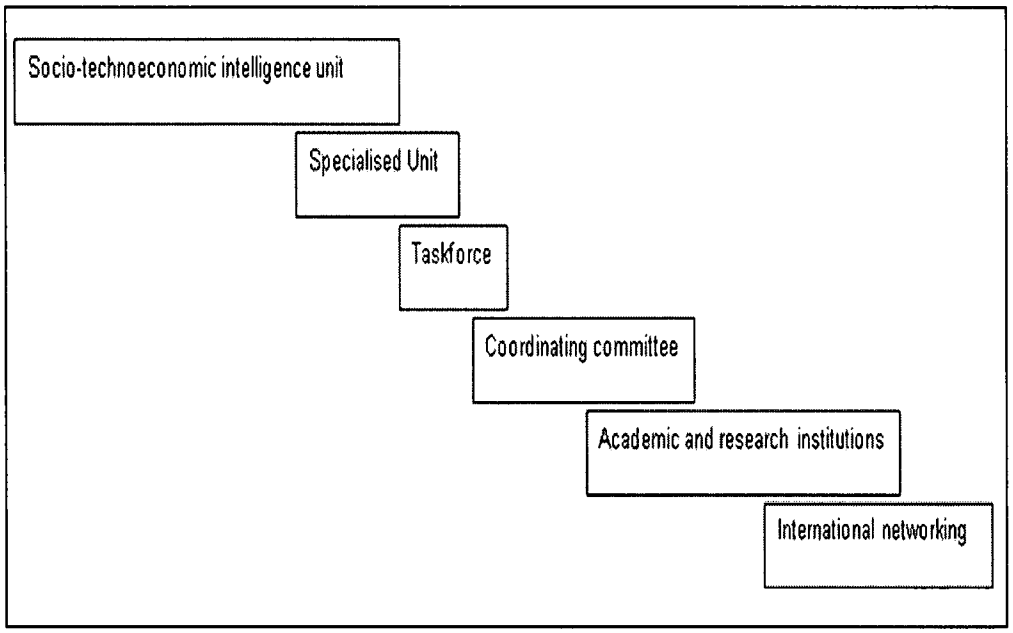


Figure 22. Constituent elements for institutional planning network (Source: adapted from Sagasti, (1992))

The constituent elements for the institutional network in planning are summarised below as outlined in the above Figure 22:

- The socio-*technoeconomic intelligence* unit: - this will consist of a small group of highly qualified professionals with interdisciplinary training and broad experience.
- *Specialised planning* unit: - this will be located throughout the country and be concerned with decisions within its purview.
- The third component given by Sagasti is the *temporal issue-oriented task forces and commissions*, whose

function will be to focus on a certain problem, usually with medium and long-term implications.

- *Coordinating committees* are to link planning units with all types of nongovernmental organisations (NGOs). Here, the NGOs include grass-roots movements, association of consumers, etc.

- The next component is the *research and academic institutions*. This component is extremely crucial; its function is to research into problems of both technical and non-technical situations

- Lastly, Sagasti proposed an *international support network*. This support network is deemed very important for benchmarking, improvement on systems and for rapid adoption to best standards.

The above summarised elements, however, seem to lack provision of entry for the traditional sector. This sector constitutes a vital component to the overall intended structure for its originality, being native to the cultural and societal setting. The sector is however often marginalised in national planning agendas (Beall and Ngonyama, 2009, Englebert, 2002, Davidson, et al., 1965). Sagasti, nevertheless, did not conclusively terminate the list of elements, but actually advised on making additional components that were not foreseen at the time of his compilation.

The author concludes that planning systems are designed and put into practice by people. It is therefore essential not to forget the role of humans. By this therefore, the system build up will need 'flexible, resourceful, resilient people who can tolerate a lot

of surprise and ambiguity emotionally while continuing to work on complex issues intellectually' (Trist, 1976). Pictorially, Sagasti's approach could be modelled as shown in Figure 23 below.

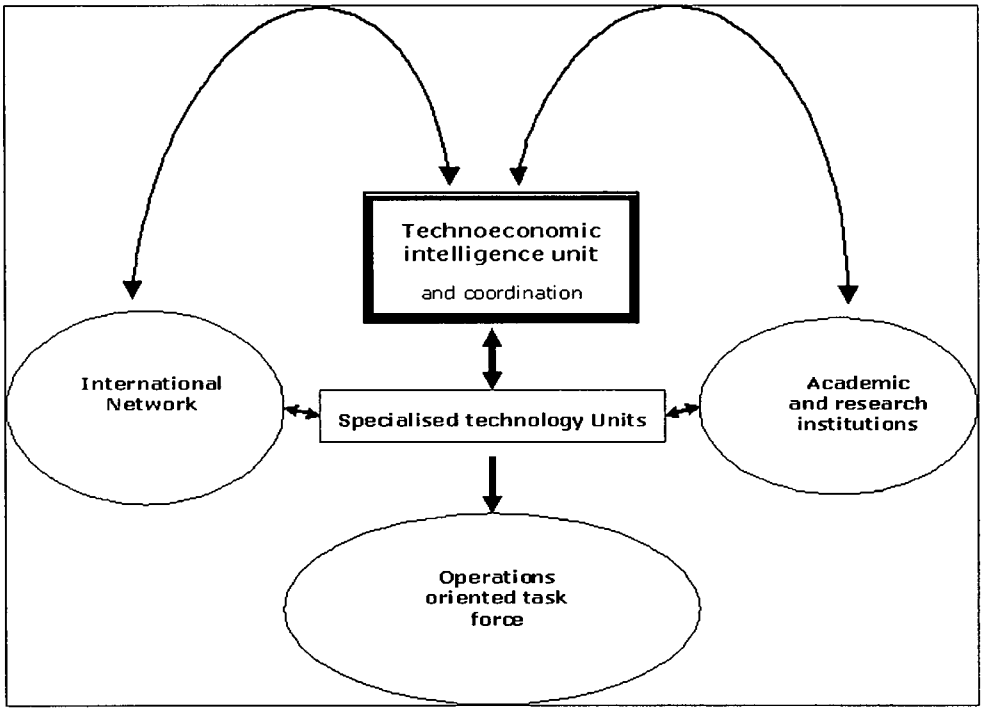


Figure 23: A new approach to development planning modified for technology system development (Source: Author)

In every case, whatever technology would be developed from this model, it should consider the views of the expanding theories on the impact of technology from other fields of study. Its impact on the human society, ecological concern, and the earth's preservation at large, encapsulated in the concept referred to as *sustainability* also calls for concern. Indeed, the subject of sustainability is of paramount importance to this study, hence the emphasis on sustainable manufacturing of technology in the overall model to be developed. It should however be recalled here that this thesis is not centred on sustainability, but

its utmost consideration in the anticipated technology creation intention is the focus.

7.2.2 Critical perspective of Sagasti's Model

The work of Sagasti (1992) was actually an attempt to address the failings confronting the theories on Development Planning that made then non-effective mainly due to their centralisation features (Soley, 1999). Sagasti therefore considered National Planning in Turbulent Times, by proposing a decentralisation approach alongside with its constituent elements. This was meant predominantly to address concerns of developing nations.

In his effort to decentralise development planning theories, Sagasti's suggested elements have indeed not been proven to be implemented or effective in any particular setting. More so, it leads to a complex network of components, which will require a certain level of systematic control system. Such level of sophistication could be a matter of concern for a developing society in general for whom, indeed, the theory is meant for. Sagasti did not seem to have catered for the level of required bureaucracy that may be involved.

Also, since his work was focused on development planning theories, and not specifically on technology development, which understandably, has not got its planning theories, Sagasti's work could not make provision for such elements to cater for technology creation for the developing countries. That notwithstanding, his work provides the platform to build a framework that could be used for serious discussion towards actually realising the intended model for sustainable manufacturing of technological systems for a society.

The shortfalls of Sagasti's work however do not appear to endanger its application in this study. This is because, though it may not have been tested proven in a planning context, its application here is in consonance with a tested proven system of operation as it is used in connection with the SIM approach.

The SIM approach, as may be recalled, works on studying and identifying a successful system of operation to be modelled. Thus, Sagasti model may be considered as useful here.

7.3 Theoretical Framework for the Ghana Model

Using the work of Sagasti (1992), as briefly shown in previous section above, in developing a model for the sustainable manufacturing of technology for Ghana, creates an independent structure for a mixed culture developing nation. Indeed, it has been mentioned that nations oriented toward development should explicitly abandon the model offered by already advanced societies (Portes, 1976) and develop their own model since they have never been successful. Thus, Ghana, having experienced persistent failures in efforts at developing its industrial capacity is therefore compelled to seek a more practicable and culturally/socially sustainable development approach to the industry. Hence, the three-step approach is considered one that may help to overcome previous setbacks.

Having made extensive literature reviews along with empirical fieldwork, this study is of the opinion that it has acquired significant amount of knowledge of the Ghanaian culture in relation to technology development across the traditional and formal sectors of the society to map out its rhythm. This chapter therefore, having identified the Ghana cocoa industry (Hill, 1963)

as an existing Ghanaian 'project', will attempt to model it as template. The process towards the institutionalisation of Cocobod (Ghana-Cocoa-Board, n.d.-a) was actually initiated by the local cocoa farmers (Hill, 1963), groomed, supported, clung to, and hence, culturally assimilated the cocoa farming. This is what made the cocoa industry successful in Ghana (ibid).

However, it is important to point out that this method has to be approached with caution. This is because the project mimics a culturally established system, and therefore any assumptions that it should automatically work out well could lead to disappointments. The caution has to be taken in the sense that all relevant factors, such as motivation, resources and skills among others which sustained the Ghana cocoa farming industry into success as a 'cultural' project, as demonstrated by the work of Hill (1963), need to be present in sufficient quantity. This is necessary for any new project contemplating the adoption of the SIM approach. If such factors are otherwise, found to be insufficient, a mechanism to stimulate or create them will become necessary conditions to be sought and incorporated.

7.4 Ghana Cocoa Farmers making the Cocoa Industry

Hill (1963) has been able to show how migration of cocoa farmers in Southern Ghana since 1892 (in addition to the work of native resident farmers), led to the creation and establishment of the industry. The aim in this Subsection is to bring out and apply the understanding of how 'the Ghanaian migrant [and native] cocoa-farmer has shown himself to be remarkably responsive to economic incentives, remarkably dedicated (within

the framework of cocoa-farming) to the pursuit of economic ends' (Hill, 1963)-(pg. 3).

In this narrative, there will be an attempt to identify and present what factors surround and motivated the farmers to leave their homelands to engage in cocoa farming in the forest. The narrative will be based mainly on the work of Hill (1963) and the motivating factors are necessary as they apply to the Ghana Model.

It can be deduced that the cocoa farmers were primarily motivated by the prospect of economic gains resulting from the exercise. The high price of the cash crop on the export market, coupled with the knowledge and skills they already had for farming, enabled the farmers to gain extra cash they had not anticipated (ibid). Though migrant farmers, they were able to organise themselves into the activities to make an impact, keeping their family lineage intact, with frequent back and forth trips to their homelands. According to Hill, '...the migration process derives much of its strength and impetus from the fact that it is firmly based on traditional organization...' (Hill, 1963)-(pg. 2).

The farmers were able to evolve their own methods of land acquisition and business model (i.e. system of operation), but 'neither was revolutionary' (Hill, 1963)-(pg. 3) as they did not change the structure of society. This suggests the social structure in Ghana (see Chapter 2 of this thesis) is not very much oriented towards transformative change, i.e. despite the adoption of a new crop as business venture, nothing was quite revolutionary. It simply meant applying their old methods of farming to a new crop for the benefits it brings.

Despite the potential prospects in the farming, individual farm size was small, typically between two to three acres per farmer. The farming activities were also mainly rudimentary except for the involvement of the Ministry of Agriculture. Government support and interest, of which the farmers were happy to work with the Ministry of Agriculture, was instrumental, and motivating. For example, the farmers received compensation when their farms were destroyed by swollen shoot, a cocoa disease (ibid). However, they embarked on the practice before government showed interest.

Though its economic gains is still a motivating factor to the famers, their returns do not reflect the high value associated with their produce (Órla and Ryan, 2011). Government however derives much revenue from the industry, hence, its institutionalisation into the Ghana Cocoa Board (Cocobod). This therefore shows how both government and the farmers stand to gain from the industry. It may be helpful to gain some insight into the history of Cocobod. The next section will therefore provide a summary of its history, description and operations.

7.5 The Methodological Template: Ghana Cocoa Board (Cocobod) in Brief

According to Cocobod (Ghana-Cocoa-Board, n.d.-a), cocoa originated from the Amazon around the headwaters in South America. It was first brought to Ghana, then the Gold Coast, in 1815 by the Dutch missionaries. The Basel missionaries were also noted to have experimented with a cocoa farm at Aburi, near Accra in 1840. These, however, did not lead to commercial production until in 1879, when Tetteh Quarshie, a native of Osu,

Accra, returned from Fernando Po (an island in Equatorial Guinea, now known as Bioko) with eleven pods and began its cultivation and growing cocoa seedlings. Other farmers obtained seedlings from his farm and began growing the crop. From then on cocoa began to spread to other parts of the country and beyond to places like Nigeria and Sierra Leone.

The produce was grown solely for export. Export of cocoa from Ghana began in 1891 with the first official export (of two bags) in 1893. Since then, cocoa export has increased to become the backbone of the Ghanaian economy (Nyanteng, 1995).

In recognition of the contribution of cocoa to the development of Ghana, the government in 1947 established the Ghana Cocoa Board (Cocobod) as the main government agency responsible for the development of the industry. The oversight responsibility of Cocobod eventually expanded to include other produce like shea nut, coffee, and cashew seeds.

7.5.1 Description of the Cocobod

Ghana is normally associated with cocoa production partly due to the historic leading role it once played as the world number one producer from 1910 until 1976 (Bateman, 1990). Cocoa replaced the oil palm, rubber, copper and the cotton industry and has been the mainstay of the economy ever since (Nyanteng, 1995).

The mission of Cocobod is to encourage and facilitate the production, processing and marketing of good quality cocoa, coffee and shea nut in all forms in the most efficient and cost effective manner. It is also to maintain the best mutual industrial relation with its objectives.

Cocobod actually had a humble beginning, when it was originally headed by a managing director. Today, it has become a huge and complex institution with a number of companies emerging from it; like the Licensed Buying Companies (LBCs), formally the Produce Buying Company (PBC) and Cocoa Marketing Company (CMC). Ghana has traditionally been known for producing good quality Amelonado cocoa, mainly for export to the industrialised countries where they are processed into chocolate and other end products (United-Nations-Conference-on-Trade-and-Development, n.d.). At the time of writing this thesis, Ghana was producing about 21% of the world cocoa (ibid) amounting to about 600,000 tonnes per annum, but Ghana is not among the statistics of world chocolate consumption. The Government is making efforts to beef up production to a million tonnes. There have been media speculations and government claims that the one million tonne target was attained in 2011. This study however could not find documentation to that effect.

7.5.2 Operations of Cocobod

This sub-Subsection outlines the operations of Cocobod based on the narrative of Cocobod respondents during the fieldwork of this research.

According to respondents, the Ghana government, through Cocobod, supervises the purchase of cocoa from the farmers and its onward sale to the international market. This is with the aim to protect the local farmers from world market price fluctuations. Over the years, there have been changes in the method of operation. As explained by respondents, the current method takes on the following narrative:

Cocobod went through a period of restructuring in 1992/93, where private licenced [cocoa] buying companies were registered (i.e. the Licensed buying companies (LBCs)).

These registered companies were not allowed to do any exporting. They were only mandated to purchase good quality cocoa beans from the farmers for Cocobod, serving as agents of Cococbod. It is Cocobod which carries out quality control checks on the beans, packages them and finally exports them through its Cocoa Marketing Company (CMC). The LBCs therefore, only act as intermediaries between the Cocobod and the farmers. And the CMC also acts as intermediary between Cocobod and the International Market. The sequence of operation could be depicted pictorially in the Figure 24 below.

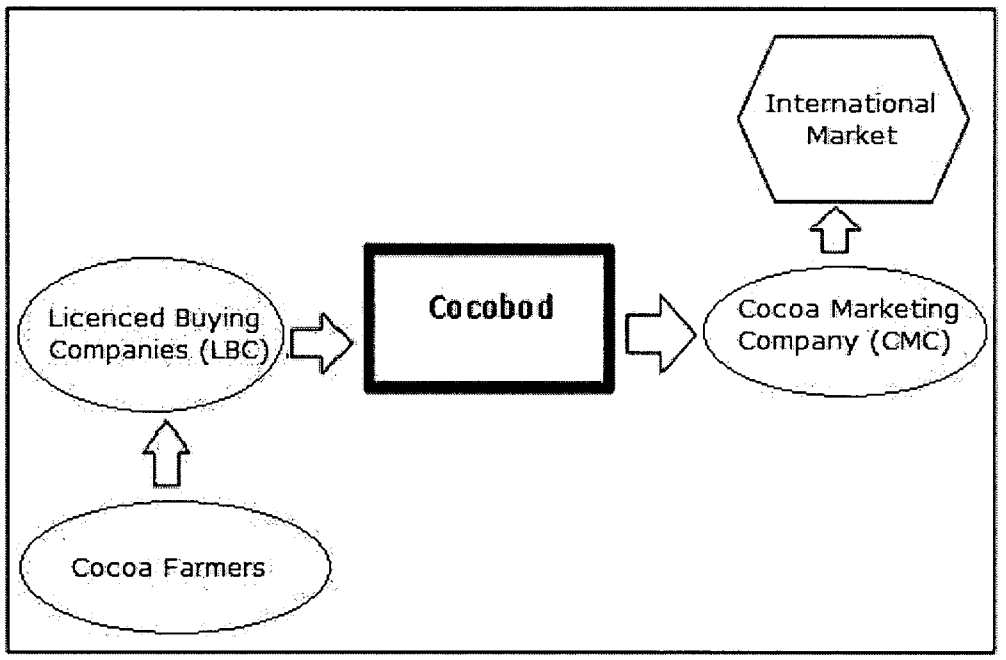


Figure 24: Operations of Cocobod to the International Market (Source: Author)

In simple terms, Cocobod sources cocoa beans from the farmers for onward sale unto the International Market. Like the LBCs,

and the CMC, Cocobod itself serves an intermediary role between Farmer and International Market, but with autonomy and power to make decisions and control its finances. This can be simply represented as:

FARMER-to-COCOBOD-to-INTERNATIONAL MAKRKET

Cocobod is in charge; anyhow it chooses to obtain the cocoa beans from the Farmers or how it sends them off to the World Market is purely discretional to Cocobod. Cocobod must device a means that best suits its business model.

Bean quality is paramount to the export operation of Cocobod. It is therefore set as a prerogative of Cocobod only.

At one time, Cocobod had to secure funds from foreign banks to assist the LBCs in their cocoa bean purchases. This was a conscious effort on the part of the Cocobod to ensure constant supply of good seeds for onward sale. LBCs members who failed to apply the funds correctly are sanctioned, thus, maintaining a high level of discipline and accountability along the supply chain.

7.6 Construction of the Model

In constructing the model, using Sagasti (1992) as framework, the various components necessary to make up the model were identified based on their description as given by Sagasti. For example; the Socio-*technoeconomic Intelligence* Unit, which consists of a small group of highly qualified professionals with interdisciplinary training to serve as the brain adequately describes what the Broad in the Model should look like. The Board will play the central role of providing the leadership and foresight for the Model. It will assume a full managerial function,

coordinating the operations of all Units to achieve its set objective.

Similarly, the *Specialised planning* unit in Sagasti's model, which is to be located throughout the country and be concerned with decisions within its purview seems to very much represent the Manufacturing Centres, established at various locations throughout the country. These Centres will be concerned with the actual manufacturing of technologies within their various localities, thus, addressing issues of cultural interpretations and historic concerns associated with any particular group of people for whom the manufacturing is being done for its local content.

The *temporal issue-oriented task forces and commissions*, described by Sagasti, whose function will be to focus on solving a particular problem, adequately describes the function of the Research and Academic Institution component within the Model. Its role will be to investigate into any pertinent technical problem or otherwise that may crop up during the manufacturing process or about the end-product. This will includes all Research Organisations and Non-Governmental Organisations (NGOs).

The role of the *Coordinating Committees*, as given by Sagasti, to link planning units with other setups could be earmarked for the Cultural Consciousness required in the Model. This Unit will link with the immediate environment, collecting valuable local information of cultural connotation. It will not only collect local information, but also serve for marketing and trade. For convenience, it will be referred to here as Traditional and Formal Sector Engagement. Its role is highly vital for it grassroots peculiarity.

Other components mentioned by Sagasti include the *Research and Academic Institutions*, which could be represented as they stand. Likewise, the *International support network*, here, referred to as International Linkages are retained as such for their strategic importance.

These components, in their equivalents, are incorporate into the construction of the Ghana Model shown in Figure 28. As indicated by Sagasti, the list he provided should not be considered as exhaustive, other pending issues could be considered and included, thus, certain vital components, not accounted for by Sagasti for their functional roles are included. These include the role of Government to serve as the overlaying body responsible for setting regulations and other forms of control; and the role of Government Agencies or Departments like the Ministry of Trade and Industry, for expanded market, Ministry of Education, etc. or for the training technical workforce and others.

And finally, probably the most important component in the Model is the User, i.e. the Local Industry, here referred to as the Local Production Enterprises. This is the Unit that will demand and use the technologies to be manufactured. Its force will determine the success of the Model. And it is this Unit that will engage in the production of the commodity (products or services) which will be traded on to provide the impetus for growth and development of the Model.

7.7 Operationalising the Ghana Model for Technology Development

Using Cocobod as template for the construction of the Ghana Manufacturing of Technology Model (GMTM), there is the need to identify some important features that may constitute vital considerations when building the Model. From Section 7.4 above, the following salient observations from the cocoa industry may be highlighted for use in the Model:

i. The farmers were motivated by the ready market for their produce, and hence, worked hard at it.

ii. The cocoa farmers, unconsciously and on their own accord built the cocoa industry. For example; 'a splendid contractor-built bridge, paid for by the migrant farmers themselves' (Hill, 1963, pg. 6) was constructed to facilitate the transportation of the cocoa beans from the farms. In addition the farmers made roads for their cargo trucks to convey their produce from the farms to the major roads leading to the ports without government support.

iii. The farmers' mode of operation and skill were traditional, an already familiar activity; their traditional farming skills was applied, in this case, to a different crop.

iv. Early enough support was available from government through the agriculture ministry for pest and disease control and research.

v. The farmers' created industry led to its institutionalisation by Government's involvement and embodied as Cocobod.

vi. Cocobod, as a single source, retains the sole right and responsibility for the export of cocoa beans in Ghana; hence, Ghana is able to maintain a level of standardised quality in the produce.

vii. Cocobod remains a Government agency, with a high level of autonomy; it pays its own staff salaries (does not depend on Government for salaries) and decides on its mode of business operation.

These features will be fully considered while developing the Model for Ghana technology manufacturing. Like Cocobod, the lead component in the Model, the Board, will source the manufacturing of the production technologies from manufacturers (presumably in Ghana), here referred to as Technology Sources, for onward "sale" to the Local Industry, which essentially comprises of the local businesses and visions of entrepreneurs. It will therefore take on similar operational sequence as seen on Cocobod, represented as: from;

TECHNOLOGY SOURCES-to-TECHNOLOGY BOARD-to-LOCAL INDUSTRY

This is pictorially denoted as shown in Figure 25 below.

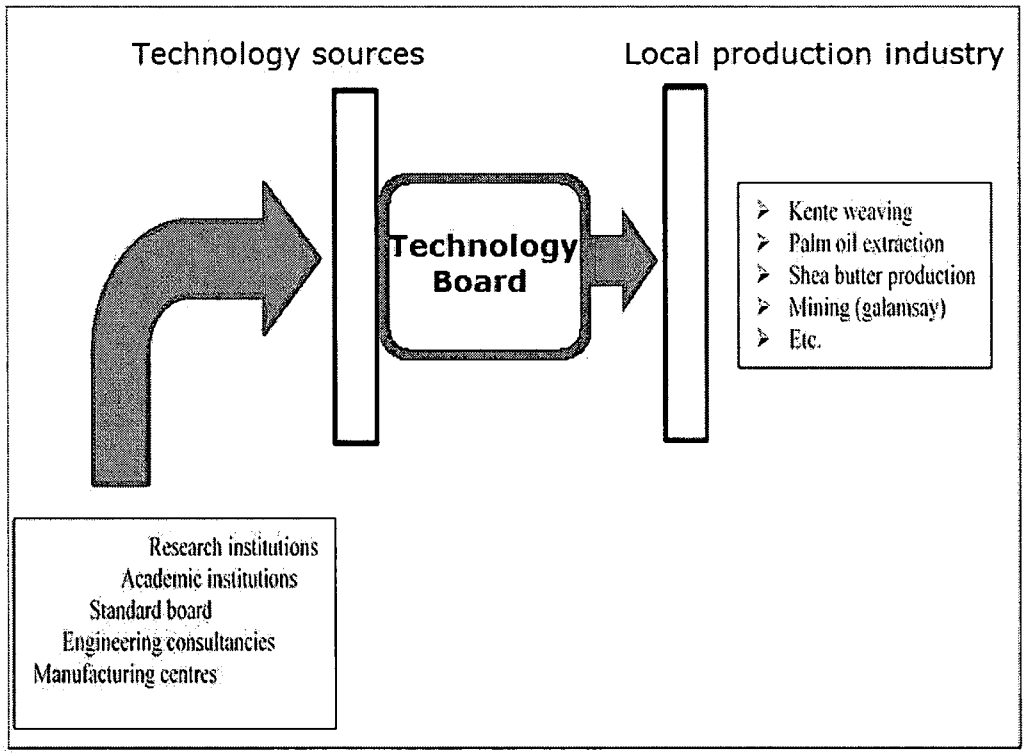


Figure 25: Sourcing technology manufacturing for local industry (Source: Author)

The constituents of the technology manufacturers as shown in above figure may include any or a combination of the following: manufacturing/engineering or metal fabrication centres, material technology centres, research institutions, academic institutions, standard boards, etc. The Board will coordinate activities of the technology sources with those of the research, academic and technical institutions of the education system. This indeed includes the technical and vocational education and training (TVET) (see Figure 26 below). Further details of this operational layout are provided in the following sub-Subsections of this chapter.

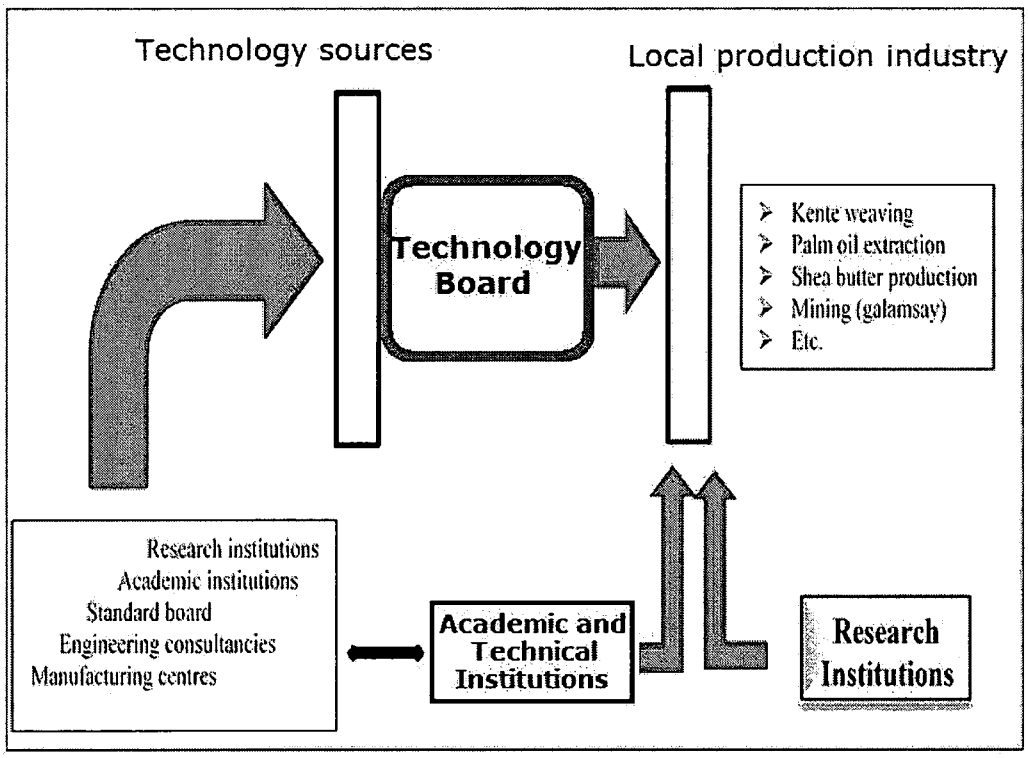


Figure 26: The role of academic, technical, vocational and research institutions

The simplified mode of operation of the Model is thus; get the technology manufactured and pass it on to the relevant enterprise, firm, company or industry.

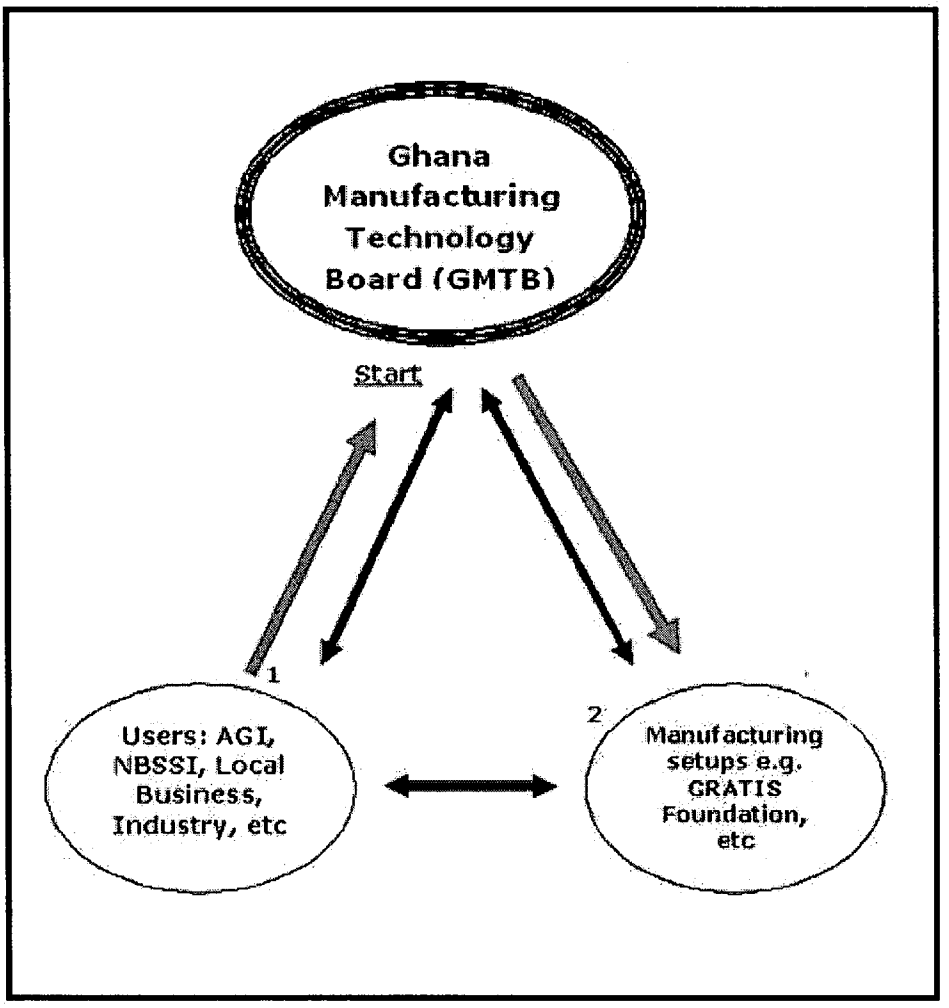


Figure 27: Simplified operationalization of the Ghana Manufacturing of Technology Model (Source: Author)

As can be seen from the Figure 27 above, the manufacturing procedure begins from the **start** point, where the Board comes to a decision on which the technology to manufacture at any point in time. This decision is reached by taking input from **users** (i.e. No. 1 in the diagram), the public or even the Board's survey of the market to identify viable technology needed for the local industry. Upon arriving at a conclusion on the decision, technology source, i.e. **manufacturing setups** (i.e. 2) is contacted for work to begin. Further details of the procedure are provided below in the following sections.

Further details are given in sub-Subsection 7.6.2 of this chapter.

7.7.1 Composition of the Ghana Model

The Ghana manufacturing of technology model (GMTM) will be seen as the framework for a system/structure/setup to be responsible for the manufacturing of technologies for local production and manufacturing in the country. This may generally be identified and referred to by its 'leading' component in the model, i.e. the board. In other words, the Ghana Manufacturing Technology Board (GMTB), which forms the brain of the overall model, will be modelled in like manner as Cocobod, the template, in terms of its functions. The Board will need to be structured with strong linkages to other institutions and organisations for efficient and enhanced operations and performance as suggested in the work of Sagasti (1992).

Unlike Cocobod, however, the Board has no such existing international market awaiting it that will readily absorb its products. In fact, the main focus of the board is for the local market, i.e. local producers. Hence, it's structuring and operations will have to take that into consideration. That is not to say, any opportunities that may arise leading to widening of its market for export of technologies will be rejected. No. Every opportunity will be assessed by the board for its profitability.

The Board, like Cocobod, will require strong government support in funding, logistics and regulatory purposes in addition to standing as a guarantee (not guarantor) international linkages for technology updates and knowledge sharing. The board will take advantage of the existing government institutions such as the research and academic institutions and work in close

partnership with material construction and fabrication setups like GRATIS Foundation (GRATIS henceforth) and its widely dispersed Technology Centres across the nation alongside the Rural Enterprise Programme (REP).

GRATIS, having the vision to become a reputable technology development and skills transfer organisation in Africa, was incorporated by the Ghana Government in 1999 with support from the European Union and the Canadian International Development Agency (GRATIS-Foundation, n.d.). Its focus is to promote small-scale industrialisation in Ghana (ibid) working mainly on metal fabrication. It has established units in every region in Ghana. This makes GRATIS to be well dispersed nationwide.

The existence of such facilities like the metal fabrication and manufacturing centres makes it unnecessary for the board to replicate them. The Board may choose to work with them to enhance their operation and stimulate production and competition among them and other similar setups.

The board may however choose to set up and operate a specialised manufacturing centre to cater for any deficiencies with existing setups.

It has been established, from the findings of this research, that local producers (local entrepreneurs) unable to afford relied on government departments and NGOs to purchase their equipment for them, this implying their inability to afford them. That is to say, *local production* businesses in Ghana are unable to afford technologies locally manufactured/produced by local manufacturers like GRATIS. It is therefore argued that GRATIS is

not competitive enough, SMEs had to import their equipment and machines for production. This position will need to be overhauled. Seeing therefore from Findings that local producers are unable to afford the purchase of the technologies, the board is encouraged to implement the advocated barter system (see sub-Subsection 3.3.2 and 4.4.2) whereby the entrepreneur pays for the technology supply with his/her products. The board may also consider leasing of the technology system under set agreement, or be a provider of service, where the technology will be part of the service package. Such arrangement for the provision of technology with a combined service leasing approach has not been found to be in use in any African country as far as this research could gather. The idea may not be new, but its application to the creation and provision technologies to local industries has not yet been found in practice in Africa.

The operation of the board in consolidating all these institutions and organisations into its framework is envisaged to intensify their operation. This is anticipated to take the form of directing/influencing/streamlining their activities to solving local technological production problems, and thus, creating and strengthening a technological base for Ghana.

By so doing, it will foster and strengthen industrial and institutional linkages.

The board should however work with a high sense of cultural sensitivity; in other words, it should be open for public engagements and actual dialogue with the traditional institutions, as in the traditional production system and the formal sector as well. It should have a quick response action system in place as highlighted by Sagasti (1992).

Its activities (linkages) with academic institutions (as with research institutions) should be extensive, in the sense that, there should be a well-established and agreed policy whereby, especially final year students' projects from tertiary institutions, should be geared towards addressing (solving) a local societal problem requiring an engineering solution. In the least, it should have some relation to such problem solving orientation to local production. This will serve as a framework, whereby, majority of students' projects will be of direct industrial relevance to the country and emerging industrial problems will have a conduit for redress. This will assist in establishing and strengthening the linkage between academic institutions and the local industries, where, hopefully, some of these students will find employment.

Students from non-engineering background could also engage in such final year projects that revolve around an engineering activity. For example, a marketing project could look at an aspect of how to market a particular engineering product or idea, etc.

Pictorially, the institutional linkages (Freeman, 1987, Freeman, 1995, Johnson et al., 2003, Lundvall, 1992/2010, Szogs et al., 2009) in the model are presented in Figure 28 below.

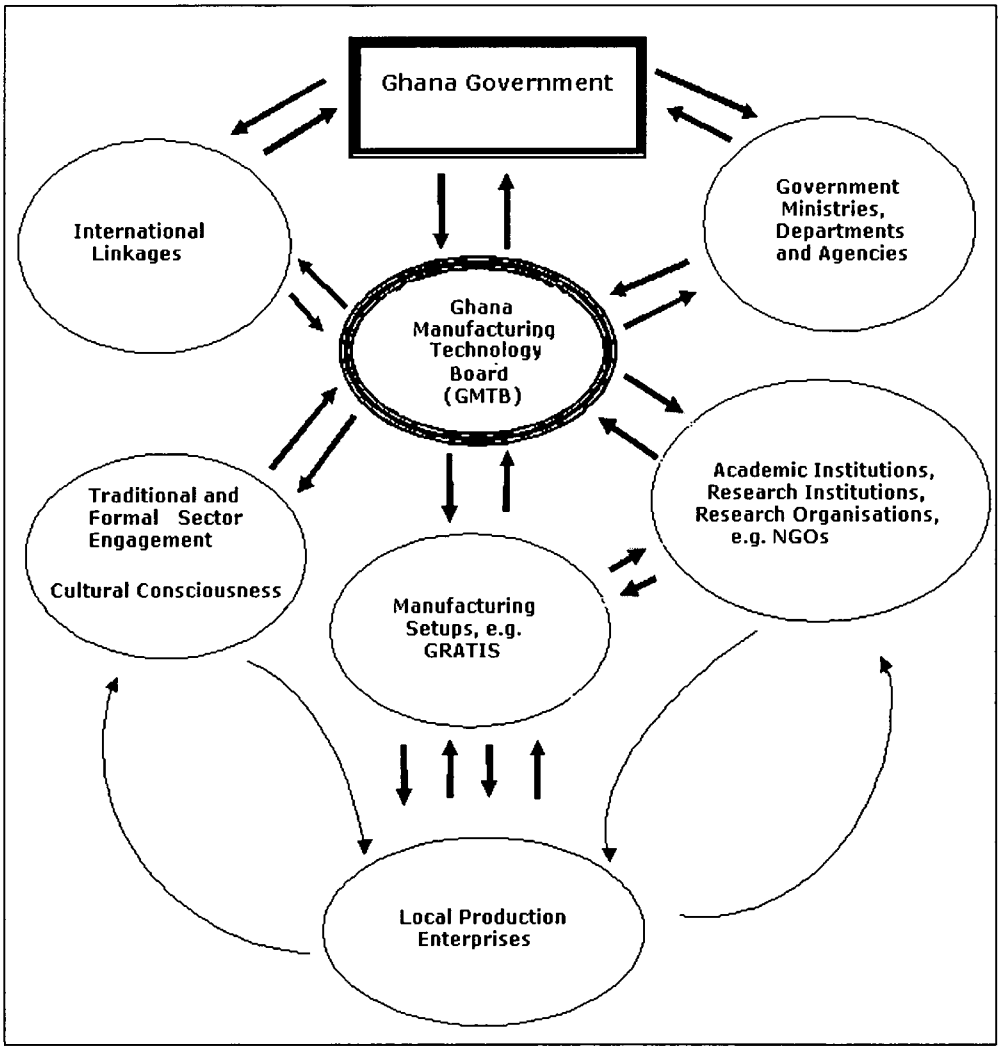


Figure 28: The Model - Components of the Ghana Manufacturing of Technology Model (GMTM) (Source: Author)

The Board, in many respects has one major similarity with GRATIS; in that the Board sees to the making (manufacturing) of production or manufacturing technologies for local industry (as previously explained), while GRATIS in similar fashion aims to 'develop, promote and disseminate technologies to industry' (GRATIS-Foundation, n.d.). This position by GRATIS has however been revised, as the researcher was informed by Respondent during fieldwork. GRATIS has moved on to a new mission which reads thus;

> *...to research, design, develop, manufacture and market appropriate technology-based products and services for micro, small and medium enterprises so as to facilitate socio-economic and industrial development in Ghana and other African countries* (Source: Field note # i8-printout).

It has become necessary for this study to clarify and differentiate its objective from the heavily loaded mission statement of GRATIS. According to the composition of the Model, as shown in Figure 28 above, the Board will relate with GRATIS like one of the constituent institutions to fulfil a task, for example, to manufacture, fabricate, weld, etc. something as may be required. It will engage with GRATIS as with any other Manufacturing Setup or Centre as need may be, while GRATIS carries on with its own form of business and administration. This will not be duplicating of function since GRATIS already operates as a manufacturing centre. Its services will only be employed by the Board as when needed.

The Board will not engage in product or machine design and manufacture. These will be outsourced to different organisations like GRATIS or others. But where deemed necessary, the Board may establish its own specialised workshop to provide a required service not available in existing setups. This is purely discretional to the Board.

7.7.2 Operational Layout of GMTB

Cocobod, as earlier mentioned, stands out as one of the success story among Ghanaian groomed and indigenously initiated systems of business. Much credit goes to the local cocoa farmers.

It is hoped that when the model of Cocobod is expanded to other areas, such as technology creation, there is a high tendency that if the appropriate steps are taken, a similar successful outcome could be repeated. Hence, the operational layout for the board will attempt to replicate the steps leading up to the success of Cocobod.

The Board, though being set up to look like Cocobod is vastly different from the latter in terms of the product line; i.e. Cocobod being agricultural-based while the board is an engineering/technology focused business entity. This means that there will be differences in the details of their comparative operational activities. In spite of their differences, they seem to have one very important feature in common, which is, they are both business entities.

The operational sequence of the model is such that the board comes to a decision on a specific production or manufacturing technology to make (manufacture) for a particular business or group of producers. Prior to the manufacture of the machine, equipment, etc. (technology), there will have to be a clear understanding well stated in a formal agreement or document spelling out without any ambiguity the specificity of the technology required, cost involved, method and mode of repayment (money or barter), etc. Different options for payment should however be made available to the clients. This should not strictly be cash or bank transfers.

The Board will liaise with other government departments and ministries like the Ministry of Trade and Industry to specifically expand existing markets and create ones for local production, hence, keeping a constant market assurance for the producers

being provided with the technologies. In this way, it will resemble the constant market available for the cocoa farmers. The board must therefore only agree to manufacture a particular technology after ascertaining its market potential, because, the board must take part in marketing the end-products of its clients' production. In fact, the board will be running its own warehouse/s and retail outlets (see Figure 27). In other words, the producers will have only one focus; doing what they know best, and that is, to produce high quality products for the board, but within an agreed price range and meeting the expected quality and other standards set by the board. All this should constitute part of the agreement. By this method, the producers could pay for the technologies supplied by the board using the products the board takes away to retail, instead of using cash or bank transaction. This is reference to reducing over reliance on the cash system.

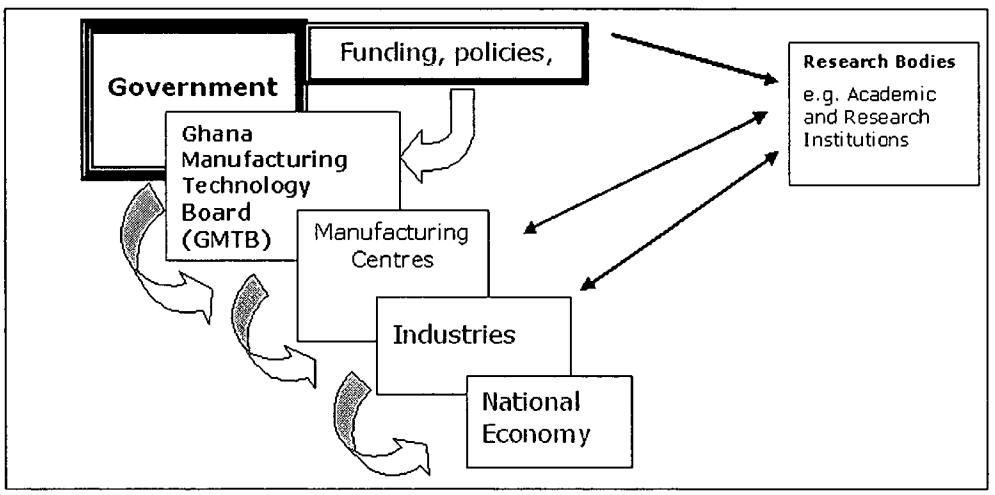


Figure 29: Flow description of GMTB (Source: Author)

The board may not be involved directly with the manufacturing of the technology; it will be outsourced to the most suitable manufacturing setups. Though, as earlier indicated, the board to

own its specialised manufacturing centre, or as may be deemed fit. Figure 29 above shows the functional relative position of the Board in regards to other functional components like the manufacturing centres, etc.

The mode (and sequence) of operation envisaged for the Board with a business focus may be explained in greater detail using Figure 30 below following the numbering in the diagram.

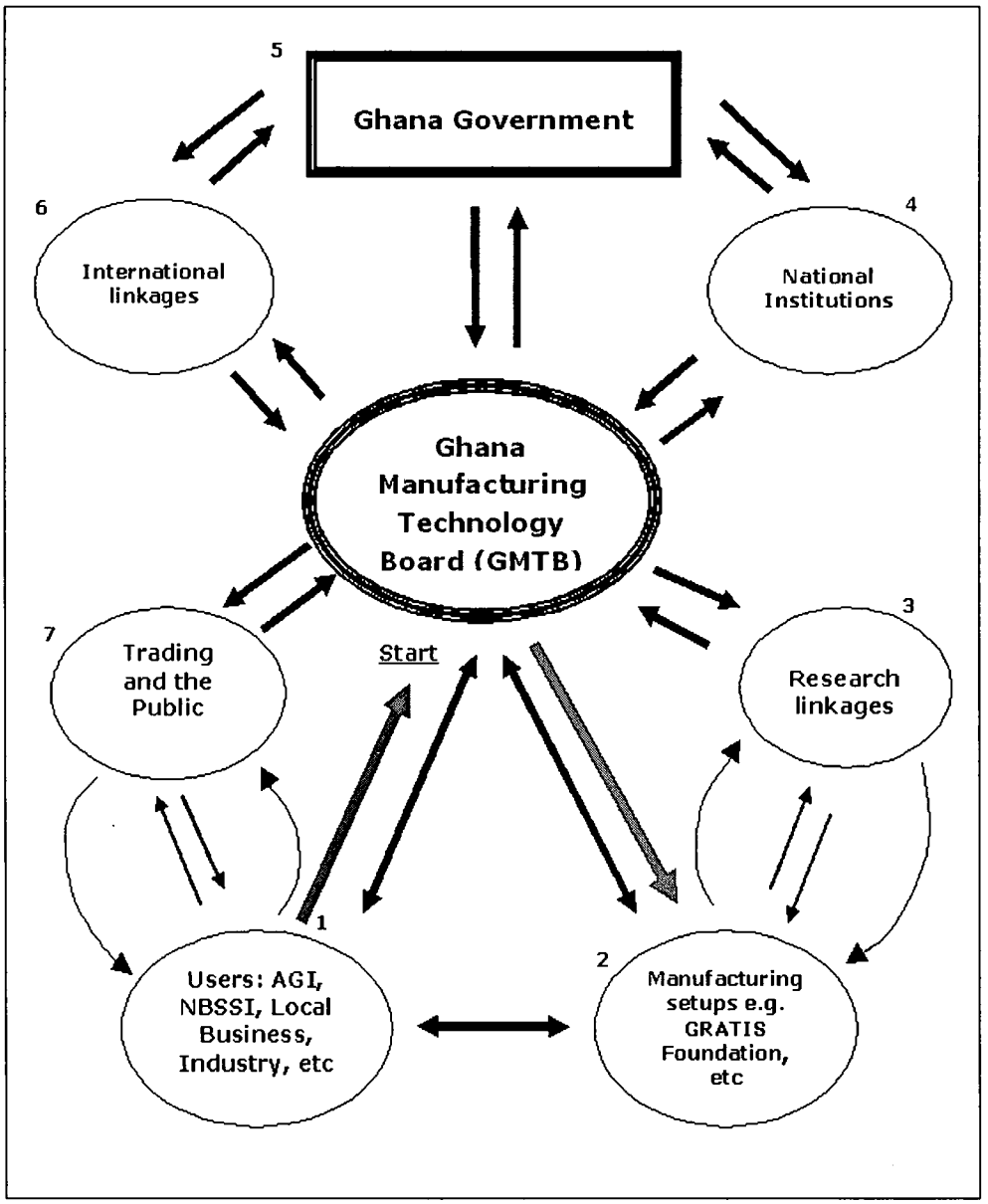


Figure 30: Sequence of operation of the GMTB (Source: Author)

The sequence of operation could be described as follows with the numbering corresponding to those in the above Figure 30:

Step:

1. The process begins at start from #1 shown in the above Figure 30. That is, the Board will have to decide on the particular *technology* (i.e. specific machine, tool, equipment, instrument, etc.) to manufacture. The decision will be based on its assessment to determine the viability of the technology. This first line of action is represented by the red arrow coming from *Users* (bottom left) and heading towards GMTB, the Board. Once an agreement is reached and work commences, there should be constant back and forth visits and communication between *GMTB* and *Users* (shown by the double arrow in opposite directions) so as to rectify any discrepancies in the agreement or introduce changes in specifications to the technology selected for manufacture.

2. After concluding on the technology to be manufactured, the Board should then proceed to manufacture such technology from an appropriate manufacturing setup, like GRATIS Foundation or any setup specialised in what is required to be manufactured. This operation is represented by the green arrow pointing from the board to the Manufacturing setups. The green colour is a symbolism for sustainability *consciousness* expected to be adhered to by all parties. At this stage too, there should be back and forth visitations and communication between the Board and the selected setup represented by the double arrow in opposite directions. The selected *Manufacturing setup* will essentially

need to be in constant contact with the *Users* as well (shown by the double headed arrow lying between them).

3. The manufacturing centres will need constant linkages (indicated by the back and forth arrows) with *Research* and *Academic Institutions* to address any aspect of design, manufacturing/production or any problem relating to the project which may require research. This could be scientific research, engineering research, social research, psychological or otherwise. The two cyclic arrows, the lower one coming from the research linkages to Manufacturing setups and the other leaving the setups to the Research linkages represent the cyclic sustainability relationship that should exist between the setups and the institutions. In an event where any production from either sides is considered not *sustainable* enough it will need to be returned by a prescribed procedure to the appropriate quarters for correction.

   While such communication is ongoing, the Board will need to be constantly linked (in a back and forth communication link shown by the two arrows from GMTB to Research linkages) with the research. This is to aid the Board to be constantly in the know of any changes to be made on submitted specification. Such changes will need to be explained without technical jargons for the comprehension and acceptance of the Board.

4. In addition to the mentioned *Users* (of the technology, e.g. AGI, etc.), the Board will need to be in a constant two-way linkage relationship with some governmental entities (referred to in Figure 26 as National Institutions). Some of

such may include the Ghana Standard Board (which sets and sees to the adherence of standards in Ghana), Ministry of Trade and Industry (MOTI) to create market for local production, and organisations as may be found necessary.

5. These institutions will be established by government, thus, having their own back and forth relationship with government (shown by two opposing arrows between Ghana Government and National Institutions).

   GMTB is also expected to operate directly under Government (*Government of Ghana*) though as an autonomous entity, just like Cocobod. Indeed, Sagasti (1992) noted, it should be interactive and decentralised. Government will need to provide the Board with working capital, which could be an estimate of its annual share capital. Such estimate could be arrived at after a concession between the board and Government. Also, Government will need to enact relevant legislation to enable the board to stand firm and adequately carry out its objectives in the manufacture and deployment of production technologies to local industry. The board will require no more support from Government.

   Government will be expected to also provide national regulations and policies that will facilitate a smooth running of the board's activities by creating a favourable and/or enabling atmosphere whereby the manufacturing processes will be rewarding to encourage and draw entrepreneurs into production. Such policy could include access to credit, availability of raw materials, policies to discourage

importation of certain machines/gadgets or products that could be manufactured by the clients of the board in Ghana.

6. Furthermore, government policies should encourage *International linkages* between government establishments and their counterpart in the world. That is to say, the board will need to liaise with appropriate international organisations and institutions to share knowledge and information to keep abreast with international standards, new developments and emerging ideas and concepts. The board should not operate in isolation from the rest of the world. A key factor in this international linkage is to set the scene for Ghana's technological body, GMTB, to have a niche presence at the global level in matters concerning technological advancement with relevance to the local needs of a developing nation. It may therefore be able to advocate for a strong and continuous uncompromised *Sustainability* practices in all the four pillars of the concept.

7. The seventh step is Trading and the Public, which signifies a dual operational activity here. The board, in essence, will engage in the trading of products and commodities produced by the industries (or factories) it supplies technology to as part of their agreement. Combined with the operation of trading, the board will put in place a sensitive mechanism to capture public concerns relating to social, cultural, environmental, etc., matters with regards to the activities in the technology creation. This is in line with the spirit of promoting the principles of the *sustainability* concept, where public concerns are addressed promptly to prevent potential conflict, degradation of human values, environmental and ecological imbalance and so on. Such

public interaction could also serve as a boost to its market prospects for the client's commodity.

The board will therefore need to arrange a thorough system of enterprise, trading in commodities mainly for the local market first, before ever seeking to export either the technology or the products from the technologies. Exporting may be imminent over time when the Ghana market reaches saturation. That is, the prospect of exporting "home" technologies abroad is not completely being discouraged, but the emphasis is on "home" consumption in the local market. Thus, the cycle of operation for the board continues. The business model of the board will be developed as a future work continuation using the Business Model Innovation (BMI) concept as its guiding principle.

Since the Board will run a warehouse trading system (see Figure 31 below) of the commodities produced by the technology *Users*, there is a cyclic relationship between the trading mechanism and *Users* (see stage 7 and 1 of Figure 30), so that, any anomalies arising from the agreements or any product defects will be returned to the industry through a prescribed appropriate channel (to be laid out by the Board). Also, there should be a relationship of back and forth communication between the Board and the clients as shown between step 7 and step 1. This is to help keep to a minimum level of errors and discrepancies. Product standards stipulated by the Ghana Standard Board should be the minimum expected standard. The Board may set

higher standards as deemed fit for any particular process or artefact.

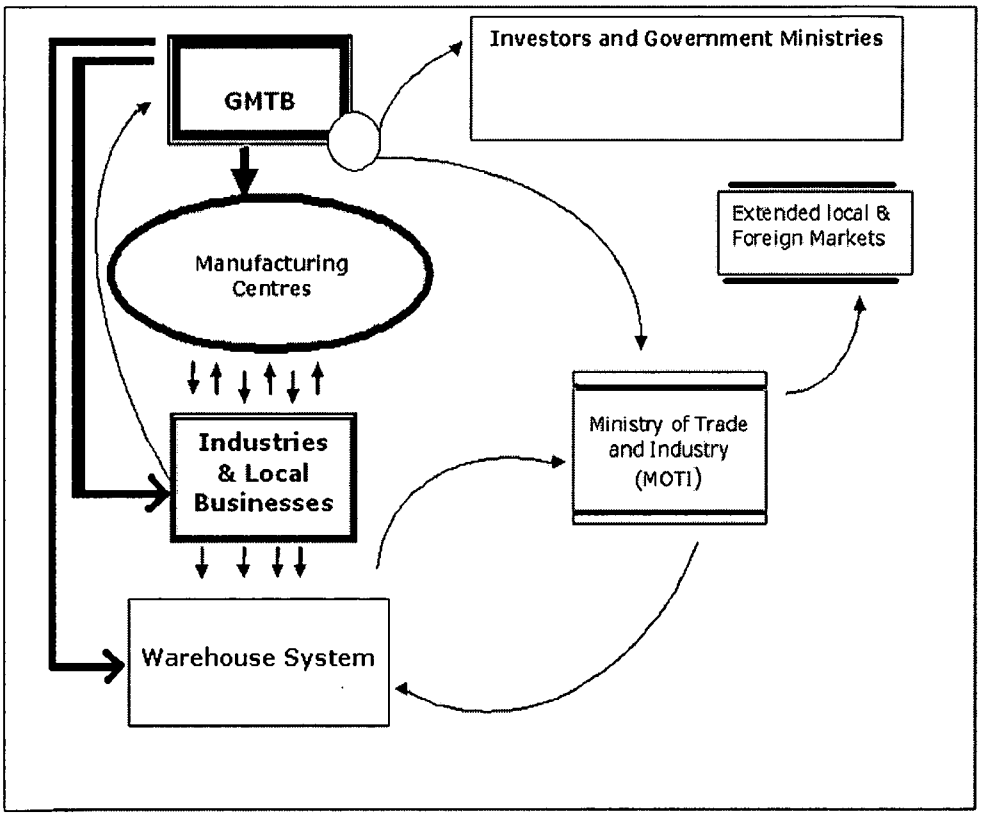


Figure 31: GMTB running a warehouse system for local products (Source: Author)

The Board should be considered as a profitable organisation like Cocobod. It should therefore be given all the necessary support for its inception like Cocobod, after which, it should be able to stand on its own, managing its own affairs in generating its revenues, as an autonomous body, with surplus to feed into government coffers as may be stipulated.

7.7.3 Future Factors of Consideration for the Board

The dynamism of the Board may demand thus; the board will need to be dynamic and anticipatory in its operations as indicated by Sagasti (1992). It must display its virtue as the socio-techno-economic intelligence unit (ibid) of the framework. The board will therefore not be static, it will constantly need to update its operations, structure and strategy (Clemens and Dalrymple, 2005) in an anticipatory manner, i.e. proactive and future focused while working on the present and using the past as a check and balance for the future (Sagasti, 1992, Clemens and Dalrymple, 2005). This is what the business model innovation (BMI) concept (Girotra and Netessine, 2014) tend to portray, blending the past, present and future in the right mix for competitive advantage.

In its anticipatory and dynamic feature, as part of its future possible outcomes, the board will situate itself at this first stage to create the system of technology manufacturing for the local industry or various industries and firms. As one industry establishes itself, the board moves on to create another, then another, then the next, until it becomes too bulky (numerous) to handle. It will then move itself one step up the ladder to a new role, but create a number of its kind (self-replicate) to replace its function in the technology creation level while it focuses on its newly assumed position. At this new one-step ladder up position, it will, take on a new form/responsibility of monitoring, coordination and supervision of the activities at the technology creation level where, at this stage, its replicated selves will be working on the technology creation/manufacturing function. See Figure 32 below for illustration.

As the technology creation function further expands, the Board may need to further assume a higher position of seeking excellence in localisation and internationalisation integration of the technology creation system. Each time it moves up, it will need to replace itself behind with its replica.

A possibility of further expansion will take the Board to the ultimate position, where there can be no higher level to attain. In this final position, the Board will be focused on control and moderation of engineering and developmental activities in the society.

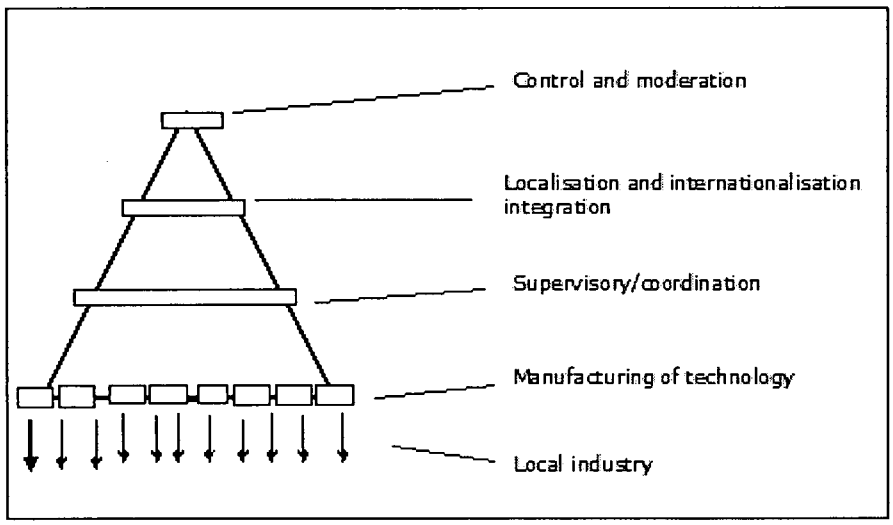


Figure 32: Illustration of the expansion role of the manufacturing model

These various levels are however for the future manifestation of the board. The present focus is to remain at the first level of technology creation, which is even yet to commence. However, the immediate future work, not in this thesis, will concern detailing the structure and operational layout of the board for its business function only, that is, the business model. That is to say, this thesis hopes to develop the working details of the board

as a separate future study not contained here in this work. This work, therefore, only introduces the subject, highlighting its relevance, i.e. the production technology creation. Appreciation and acceptance of its relevance will serve as a positive signal for future work on the subject.

As part of the highlight, the emphasis on the sustainability concept will need to be carried through. It may therefore be helpful to see how the concept fits into the structure of the model. The following Section 7.7 gives a brief account of the sustainability concept in relation to the function of the board.

7.8 Sustainability Concerns in the Technology Manufacturing Business Model of GMTB

The issue of *sustainability* (see Section 4.4), to be developed as a separate study elsewhere, is given paramount consideration in this study of technology manufacturing model framework being developed in this thesis. Its mantra is to apply sustainability consciousness to every stage in the technology creation process. Any part in a particular stage identified not to meet the minimum set standard should not be moved to the next stage, but be rectified (returned to the appropriate unit for rectification). Figure 33 below is an attempt to show how the sustainability concept will fit and function within the framework.

Using the diagrammatic representation of the figure below, the cyclic arrows to the right, one coming from the academic and research institutions is double-lined (thick) representing feedback to the manufacturing technology centre. The single-line (thin) arrow returning to the institutions signifies a return of any

industrial problem solved which is found not to be sustainable enough.

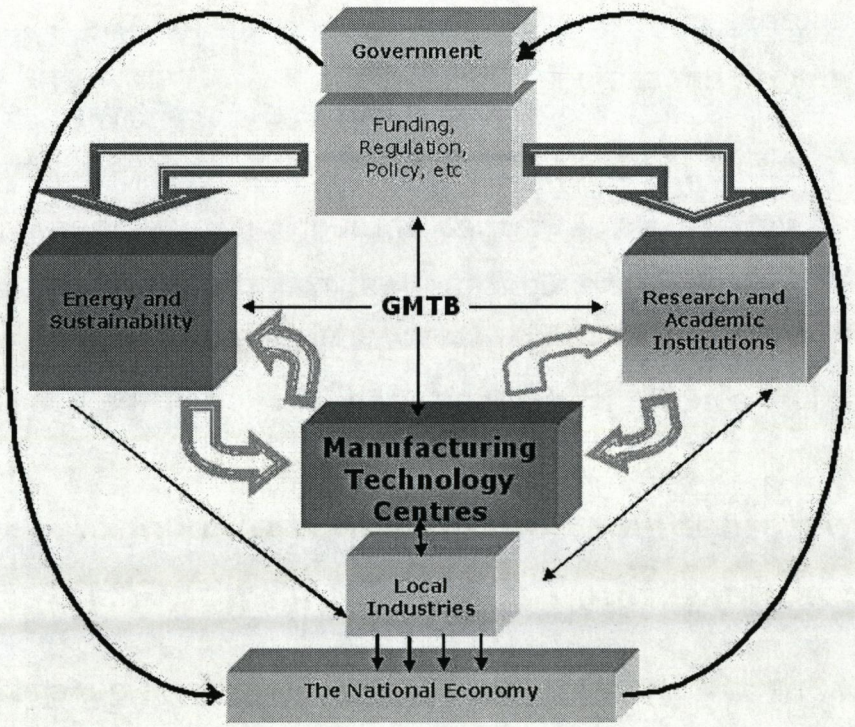


Figure 33: Ensuring sustainable manufacturing of technology (Source: Author)

The criteria for the sustainability assessment will be decided on (based on) a framework acceptable at the national level. Since the application of sustainability, to a very large extent, is subjective, as there is yet no standard method that could be prescribed to apply to all situations, a convincing and satisfactory framework will therefore need to be developed to this effect. Such a framework should be all encompassing, for example, the life cycle assessment (LCA) framework is a popular methodology used among industry, because it considers the entire life cycle of the product, from extraction of raw materials through to the manufacture of the product up to its usage and disposal, i.e. its

return to earth. The LCA framework is often referred to as 'cradle-to-grave' (Curran, 2006). Developing the details for such a framework for the operations of the board, however, falls outside the scope of this work due to time and space constraints and as such will be left for further study in a separate work. Nonetheless, it is emphasised here for purposes of completion that for an acceptable manufacturing approach, the whole process will have to be sustainable, that is, it has to be *'green'* enough (Schot et al., 1997, Kaebernick et al., 2003a, Sutcliffe et al., 2009, ISO-14040, 2006) for it to be deemed sustainable manufacturing, hence, the green colour representation shown in the above model.

7.9 Constituent Roles in the Model

The board takes on the generic role of providing local industries with their required production/manufacturing technologies for their various production systems, though not limited to such only. It may assume an oversight responsibility over matters relating to technology and local productions. For example, almost any institution in the country could request from the Board the design and manufacture of a specific technological system for its operations. This could be, for instance, if Cocobod decides to process 90% of its beans, it could call on the Board with its request and specification. So can the traditional Textile Producers request of the board for their specification of technology to aid them in their production. This therefore implies, though the Board is setup for traditional local production systems, its function will be applicable and useful to almost all industries across the country. The Board therefore stands as an overlaying

organisation superintending matters of production/manufacturing technologies.

The Board, the brain of the Model, is therefore a major actor in the framework playing a leading role working closely with local industry and as a major actor will absorb (use) the technologies produced/manufactured. Without the absorptive capacity of the local industry, the Board will have no justification for its existence.

The role of the Board is therefore most indispensable, and as such will require the best of talents and experience for high competence, hence 'it will consist of a small group of highly qualified professionals with interdisciplinary training and a broad experience on development problems' (Sagasti, 1992)-(pp. 340-341). In this case, the composition of the Board may require expertise in the areas of manufacturing principles, business dynamics, finance and cultural interpretations. Its interdisciplinary nature will therefore mean incorporating other relevant knowledge as in sociology, psychology, history and other disciplines as may be found necessary. The Board is therefore expected to be composed of flexible, resourceful, resilient people who can tolerate a lot of surprise and ambiguity emotionally while continuing to work on complex issues intellectually (Trist, 1976).

A question that may arise is; how is the Board going to access funds to engage in all the potentially numerous projects that may come up? This has been answered that government is seen as the initial financier for the Board, to provide the initial working capital, as was the case with Cocobod in 1947 (Ghana-Cocoa-Board, n.d.-b). In addition, government will need to set up,

using an Implementation Model from a future work, all the necessary legislative apparatuses, regulatory mechanisms and initial infrastructure, after which, the Business Model of the Board should be able to make profits to cater for itself and its subsequent growth.

The production or manufacturing centres serve a pivotal function in the creation of the technology. They are responsible for the creation of the required technologies.

Very important bodies in the composition of the Model are the research centres, here identified as the academic and research institutions, or research linkages. Indeed, they act as the strings for growth; the Board will be highly reliant on these research setups to address pertinent technical, scientific, technological concerns.

These institutions will be expected to be innovative, constantly generating new ideas in design, manufacture and production. They will also be responsible to solve problems to make the manufacturing centres more efficient leading to the production of more efficient and cost-effective technologies.

The public (Wynne, 2006) is seen as an engrafted, yet an indispensable actor in the Model. Embodied within the public is the composition of social structure, culture and traditional (indigenous) institutional framework recognised for the necessity of their input, consent, participation, effective communication (Rowe and Frewer, 2005) for a cultural sensitive feature of the Model. This component is considered as possibly the most vital in securing the success of the Model, as it is aimed to be culturally engrafted, that is, totally assimilated into the culture of the

society of its implementation. This is to meet the SIM Approach demand.

Other actors of relevance in developing their independent relationships with the Board are such entities as Government Ministries, financial institutions, NGOs and other relevant organisations within and outside the boarders of Ghana.

7.10 Testing the Proposed the Model

The aim of this research, as previous stated, is to come up with a framework for sustainable manufacturing of manufacturing or production technology for local industries in Africa, focusing on Ghana. The model emerging from the proposed framework was initially tested with respondents on the field for modification and streamlining. The modified outcome was then tested in a presentation at a PhD seminar series at the University of Nottingham and further tested at the 2014 Production and Operations Management Society (POMS) international conference.

It should be noted however that the Model cannot be tested as in engineering. Probably, the only valid engineering form of testing that can be accorded it is when it is implemented. However, the term, testing, is used to attempt some form of testing. The Model was therefore tested by seeking the opinion of knowledgeable professionals some of which include:

- Government Officials in Ghana at the Ministry of Trade and Industry (MOTI), National Board of Small Scale Industries (NBSSI) and Cocobod.
- Heads of some tertiary academic institutions in Ghana

- Two occasions of PhD Students and Supervisors at an international conference and a seminar in the UK
- Members of the Production and Operations Management Society (POMS) at their 2014 conference in Singapore

The audiences concerned were emphatically made aware of the intention of testing the methodology developed for the manufacturing of technology in Africa, focusing on Ghana.

The initial sketch of the model tested with respondents, who are mainly government policy makers and heads of academic institutions, produced varying degrees of reactions, which can be classified as the supporters and the sceptic groups: One set of respondents was positive and saw it as a good model that should work and be able to change the low productivity narrative in Ghana; while the other set saw it as an unnecessary addition to already existing institutions. Below is a brief narrative of the responses.

For example, according one of the respondent who saw it as good way forward, remarked that he had previously anticipated a similar concept, which he states thus;

> *I once proposed something on that line, which I called Science, Engineering and Technology Council. I suggested such a council should have the placement, such that it reports directly to the President. Its task would be to design and manufacture; to come out with products that are strategic for national development. For example, over 90% of our cocoa is exported for decades. Government could induce companies in design and manufacturing to*

transform our raw material into finished goods (Source: Field note #i10-a12).

This proposal by the respondent, which was part of a talk delivered at a ceremony, seems to have simply ended there with no development on the subject. The institutional arrangement or framework seems absent here for implementation, thus allowing for impressive speeches and lectures to be presented to audience and only applauded and hailed as great, but without an agenda for usage.

The other bloc saw the framework as unnecessary. There, they claim many of such institutions already exist in Ghana aimed at technology development. Examples given among others included institutions like the Ghana Standard Board (GSB), Association of Ghana Industries (AGI) and Council for Scientific and Industrial Research (CSIR). The notion expressed by this bloc alludes to a strategic approach undertaken by Ghana (see 'ix' of sub-Subsection 6.3.2) and sees this framework only as one of such institutional setups already in place. For example, according to the words of one such respondent;

It looks like we have the body already, except that we need market to publicise the activities of this body. I am talking about Council for Scientific and Industrial Research. If we collaborate with them, we may be able to bring out this manufacturing. We have the Industrial Research Institute that is one of the organs of it; we have the Building Research Institute. These are geared towards this manufacturing. They also look at the local need and then try to create things to suit that. So I would like to say that there is a body there already, except that, we

haven't publicised their work and marketing them (Source: Field note #i11-a12).

Such perspectives from government policy makers as respondents exhibit a misconstrued perception of existing public and private institutions in the country. The role and development of technology, as found by this study and in harmony with existing literature, shows an almost total absence of a consideration to answer the technological needs of local industry. Take for example, according to the observation of some previously cited authors;

> *Several business associations exist in the country* [Ghana]*, such as the Association of Ghana Industries (AGI), the Association of Small-Scale Industry (ASSI), and the Private Enterprise Foundation (PEF). They all play an advocacy role for the private sector, but their focus is mainly on such issues as access to credit, trade policies and management training. Technology issues are conspicuous by their absence* (Lall and Pitroballi, 2002)-(pg.147).

The conspicuous absence of technology issues, as noted by authors, is what is probably reflecting in the opinion of the respondents in not seeing the novelty of the proposed technology framework actually differing from existing institutions in the country. The fact is that, the claimed existing institutions have always been there while the business community continues to lack production technologies and rely on importations. This is largely because; they were not set up for the purpose of addressing the country's technological needs.

Their non-positive opinions were however carefully studied against the backdrop of the Ghanaian economy and failed industrialisation attempts discussed in Chapters Two to Four of this thesis. These opinions helped to streamline the framework to address some pertinent issues like vagueness identified among policy makers in relation to the subject of discussion, in addition to the isolation of the traditional sector from decision making towards modernisation and industrialisation. Concerns of the rudimentary traditional technologies, secluded to the rural dwellers, were found not to form an issue of consideration at the governmental level in the national development agenda.

It may be concluded here from the responses that, for the fact that Ghana's industrialisation attempts failed, it gives much credence for the study to continue. This is further strengthened by the support of those who see the need for it, mainly those with the positive responses. More so, the institutions alluded to by the respondents have their specific roles, mainly as research institutions and not manufacturing. Similarly, as espoused in Number 'ix' of sub-Subsection 6.3.2, other institutions assumed to take on the role of manufacturing, were indeed misconstrued for their various functions. This, given that (as deduced from the study on the Ghanaian society, both from literature and fieldwork), the Ghanaian society, and indeed, the African society, does not thrive well on western-style institutionalisation, on which most institutions in Ghana are modelled. Thus, these institutions are mostly described by authors as weak, inefficient, and so on (Szacs 2009). It is therefore suggestive that the weakness, confusion, ineffectiveness, etc., of these Ghanaian institutions are closely associated with the models on which they

were constructed. Hence, perhaps the failed industrialisation attempts.

It may be worth stating clearly here that the model developed from the framework proposed in this study differs from those of existing Ghanaian institutions in that its construction follows the three-step methodological approach, drawn from the work of Clemens and Dalrymple (2005), and is not known to be previously known, as far as this study covers. Neither has its application been identified anywhere else by this study. This approach, in fact, debunks existing development models and methodologies, mainly because, none of them have been able to successfully transformed any African country's low state of technological or economic background into a prosperous society. The three-step approach, indeed, allows both the formal and informal sectors of the economy to actively participate in the development agenda through a synchronisation of the development intent with the cultural setting of the beneficiary society. This is what the authors referred to as *entrainment* of the rhythm (ibid).

For example, the model is applied to the shea butter industry, to highlight its methodological approach to understand the cultural interpretations and connectivity of the traditional production process. The understanding gained will be used in devising what mechanism, approach, system of operation, etc., or methods to be adopted or developed to enhance the production process. This will be done in close collaboration with the concerned party for its cultural assimilation. At the moment, as found by this study, such approach is not used and the shea butter industry (as in other local industries in Ghana) is being propelled on the same

path as the unsuccessful industrialisation attempts that have marked Ghana, and indeed, Africa's industrialisation narratives. Taking a closer look at the shea butter industry in Ghana through the case study might be helpful at this stage.

7.11 Relevance of the Ghana Model (GMTM) to other African Countries

The model, aimed at technology creation for local industries in Ghana for value-added production, is arguably, applicable to all industries as previously mentioned. Ghana's continuous reliance on primary produce, as a common description of African countries (Juma 2011), has the hope for a change with the prospects of the GMTM. Figure 34 below depicts the board (GMTB), under Ghana Government, providing technology to industries around the country.

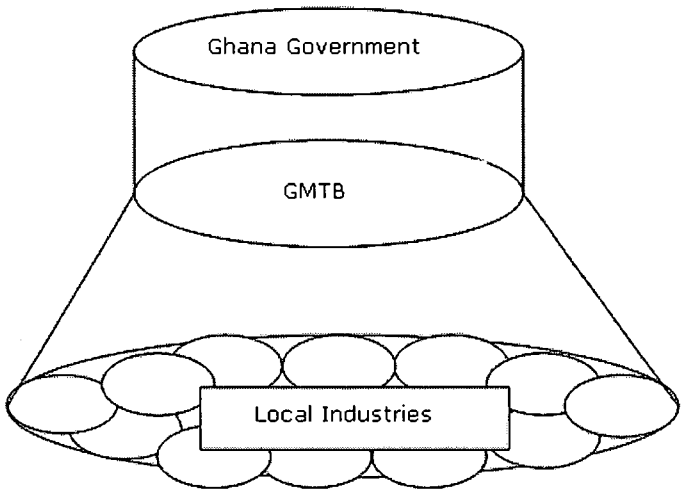


Figure 34: Ghana model of providing technology across board to local industry (Source: Author)

This structure is conceivably applicable to the rest of Africa if individual governments decide to set up their own versions of the

model. Some of the envisaged benefits of such approach will be an eventual local industry-to-industry collaboration across national borders (see Figure 35 below). This could lead to proliferation of specialisation in specific production areas, enhanced supply chain management system and better understanding of collaborative production ethos which cut across African countries, thus, linking industry to industry.

The figure below is an attempt to depict such industry-to-industry collaboration across African nations. It is believed such collaboration will lead to an eventual increase in productivity, which could spill over to the rest of the world.

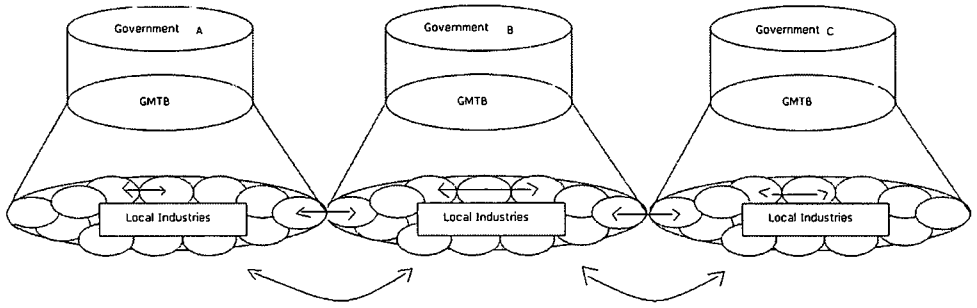


Figure 35: Application of the Ghana model to other African Nations, termed A, B and C (Source: Author)

7.12 Chapter Summary – Relevance of the Ghana Model

It has been stated a number of times over in this thesis, that Ghana, and Africa indeed, has without number failed in its industrialisation attempts. A workable approach is therefore required with some promise of hope for success. This study, after extensive research to identify and understand the possible causal effects and seek a remedy, has deduced the three-step methodological approach attached to this model. This three-step approach is seen to provide plausible means to address the African problem of technology underdevelopment.

The fundamental principle behind the model is the *sustainable* manufacturing of technology needed locally, and hence nationally for industry. This is carried out in an atmosphere of cultural assimilation, thus, it becomes part of the society and not seen as a foreign imposition that needs to be rejected. The three-step methodology therefore helps to rhyme the technology development agenda with the natural rhythm of the Ghanaian society, with applicability to the rest of Africa as shown in Figure 31 above.

CHAPTER EIGHT

8.0 CONCLUSION

8.1 Introduction

The main focus in this thesis was to contribute to previous and ongoing efforts towards the search for a lasting solution to the perennial problem of technology underdevelopment in Africa, here, taking Ghana as the case study. The research posited that Ghana (as in Africa), lacked a strong technology base, but needs it the use of technology to transform its natural resources into finished goods. In an effort to addressing the technological needs of the country, this study was therefore concerned with developing a framework for the manufacturing of production technologies in Ghana, with Africa on the hindsight. The technology creation processes and the technologies to be manufactured must be sustainable, hence, emphasis on all round sustainability.

Africa has been known throughout history, as noted by historians, to be persistently resistant to technical change. In view of the long historic and chronic nature of the African technology underdevelopment problem, this study saw the need to approach the subject matter with utmost caution. This required the need to, first of all, better understand the situation before proceeding to suggesting a panacea. To do this, the study was guided by the research question, which sought to identify what factors accounted for or contributed to the state of technology drawback in Africa, so as to be able to provide a level of explanation.

Addressing the research question, the study adopted a format whereby a three-step overarching methodological approach, drawing from the work of Clemens and Dalrymple (2005), was employed. This approach sought to map out the natural "rhythm" of the Ghanaian society, by firstly, carry out an initial *study* [S] of the society to understand its culture, history, economic trend and political landscape (see Chapter Two of this thesis) with the aim to identify any trends or factors that could explain reasons for the drawback. Secondly, *identify* [I] a "success project" from within the studied society. This "project" will have to be culturally assimilated and sustained by local initiatives. And thirdly, *model* [M] the "rhythm" of the "success project" as a template for the development intent. In other words, any potential project to be implemented will need to be modelled to synchronise with the natural cultural rhythm of the society according to the rhythmic pattern identified with the "success project". This is what the authors described as entrainment of the rhythms. The steps involved are simply to: study, identify and model the rhythm, otherwise called, the SIM approach.

This three-step (or SIM) approach, was therefore employed in this study for the case of Ghana. Using the work of Sagasti (1992) as a framework, a model for the manufacturing of production/manufacturing technologies was constructed.

The most suitable research approach found for this study was a mixed research approach. The methodologies involved in this mixed research approach include; ethnography, grounded theory and case study (see Chapter 5 of this thesis).

The ethnographic study took the form of micro-ethnography due to time constraint. Here, the researcher went to live in two different rural communities for one month and one week. The aim there was to understand how the residents, though deprived of modernisation, manufactured (made) the artefacts they needed for their daily survival and to go through their production narratives. In addition to the rural experience, the ethnography also included interactions with the urban dwellers, where government officials, policy makers and heads of institutions, business owners and executives and other professionals, like the High Court Judge, Customs Officers and others were interviewed. The methods employed in the ethnographic study were observation, participant observation, discussion, semi-structured and structured interviews for the professionals. The corpus of data collected was analysed using the techniques in grounded theory. This was to derive the narratives or emerging theories grounded in the data. The ensuing narratives discussed provide the theoretical contents that explained, to a certain degree, the African situation of technology underdevelopment, here, from the perspective of the Ghanaian society.

The case study part of the methodology was concerned with the shea butter industry in Ghana. This was to map out the rhythm of the Ghanaian attitude displayed towards manufacturing of its production technologies in the particular industry. The case study presented interesting findings which pointed to the Ghanaian society as not having much intention on developing technologies for its local industries.

Thus, studying the Ghanaian society from literature and fieldwork, the study identified a number of issues which could be

deemed to hold certain bearing to discussing (explain) the subject in hand. Some of these include: the Ghanaian society being divided on tribal grounds and lacked homogeneity and cultural cohesion; the societal setting, though culturally and rich in indigenous technologies, lacked the impetuous for its advancement, thus, remaining undeveloped and highly rudimentary in all cases in as much as the local producers wanted to use more efficient technologies, they could not afford them and looked up to government to provide. Similarly, the small-to-medium-scale enterprises (SMEs) worked with obsolete machines. The government institutions were more focused on developing high-technologies like nano-tech to catch up with the advanced world and not giving much attention to meeting the technological needs of the local business community. The traditional (cultural) Ghanaian society esteemed the wisdom of their ancestors and seemed to have lost the impetus to improve (develop) a culturally inherited knowledge, technological artefact or production methods. Indeed, it was noted that they lost their writing skills as opposed to not having it at all. Seeing the society lacked the urge to advance its system, an interest in that area therefore required a catalyst to stimulate the needed drive. The model constructed for the technology manufacturing seemed capable of serving as such a catalyst.

The model constructed by the study was therefore developed to cut across ethnic, social and political barriers, to incorporate cultural sensitivity in developing the needed technologies for the production local industries.

Using the earlier mentioned SIM approach therefore, in studying the Ghanaian society, the Ghana Cocoa Board (Cocobod) was

identified as the "success project" to use as template to model the manufacturing of technology intent. The cocoa industry presented a cultural connectivity, in that, it was well assimilated into the fabrics of the Ghana society before government even took notice and institutionalised it.

The ensuing model, consisted of a number of units, of which, a central unit served as its brain. This unit was termed, the Ghana manufacturing of technology board (GMTB, or simply the board) and its operations mimicked that of Cocobod, its template. This mimicking however took note of the difference in the end products of both institutions; for example, while Cocobod dealt in primary produce, as in cocoa beans, cashew seeds, etc., without any value addition, the board on the other hand was concerned with tertiary productions, that is, manufacturing of production technologies for local industries. These technologies may include diverse types of machines, tools and equipment required by the industry. The difference in product output therefore meant that the board will have to operate in a manner to best suit its function and deliver best output for long-term sustainable profitability.

Future work in this study seemed to lead mainly towards the development of a concept for technology creation for the technologically deprived developing world, by the society concerned. This was tentatively termed, *development engineering*. The concept of *development engineering* was envisaged to build upon the SIM approach, i.e. the three-step overarching methodological approach as its initial principle. The vision was for it to lead to an indigenous technology

development initiative, spurred by the institution of the developing society.

This study therefore seemed to initiate a new offshoot in manufacturing engineering, where the emphasis will be on how technology could be developed in and by a society deprived of technology for its economic growth. This offshoot may open the way for an engineering participation in the discussions on technological issues that have for long been dominated by to other fields of study like sociology, economics, geography and others.

It may be worth noting here that the anticipated concept of *development engineering* differs from appropriate technology (AT) (see Subsection 3.2 of this thesis) in that, *development engineering* is not necessarily geared towards developing technologies for the poor, as AT typically stands for. The general understanding of AT technologies take on such descriptive terms as; low-tech, labour-intensive, renewable, and others. Indeed, *development engineering*, even when (if) it leads to a technology form developed for the poor in any particular occasion, is not limited to such or solely intended for that purpose, or defined thereby as is seen in the case of AT. *Development engineering* uses the three-step (SIM) approach and it could result in any level or form of technology to be developed. This could be low or high-tech. The essential variance from AT is that *development engineering* will have to result a locally initiated manufactured output and be improved upon (developed) by institutional arrangements and structures put in place by the society. AT, on the contrary, does not work on the SIM approach and its technology delivery is embedded in the goodwill of kind hearted

observers who are mostly outsiders to the beneficiary society. AT developers, mostly concerned with the poverty levels in developing countries, like those of Africa, go at lengths to identify the problem, then propose; design; manufacture; produce technological solutions they deem fit to address the situation to be implemented there. In simple terms, technological solutions provided by AT emanate from outside the beneficiary society, i.e. exogenous, while *development engineering* seeks the contrary, that is, taking on an endogenous position.

8.2 Aim and Objectives

The aim in this research was to develop a framework for the sustainable manufacturing of technologies, with specificity on manufacturing or production technologies. Both terminologies are similar and often used interchangeably in a wide range of fields. However, due to the speciality of this study, a level of clarity was required to distinguish between their usages. Sub-subsection 4.2.6 of this thesis provides a distinction between the two terminologies. There, it was established that the act of manufacturing preceded production, in the sense that, a product was first manufactured (a finished product or prototype) before its production (replication into numbers) takes place. Production is therefore seen more in the line of replication for quantity, while manufacturing has to with "making" the product, as in; bringing it to existence either as prototype or finished product.

The objectives to achieving the expressed aim were as follows:

i. Study the Ghanaian society for its cultural interpretation in relation to manufacturing of its technologies for local production so as to understand the phenomenon of its technological lag.

ii. Use the understanding gained to construct cogent narratives capable of satisfactorily explaining what factors account for the drawback state of technological development in Ghana.

iii. Draw upon the narratives generated from data to apply on a case study of shea butter production in Northern Ghana to highlight the Ghanaian attitude and policy towards technology manufacturing.

iv. Develop a model for Ghana to sustainably manufacture some of its needed production/manufacturing technologies for local industry for value-addition to traditional primary produce.

In retrospect to the intricacy of the subject at hand, achieving the above aim and objectives were considered to require careful thought in deciding on a methodology. The methodology should lead to providing a certain level of understanding of the human behaviour in society, in this case, relating to technology manufacturing.

8.3 The Three-step overarching Methodological Approach

The African technology problem was seen here as complex and chronic. It indeed, it defied all known approaches and methods employed by various government regimes, the international community and donor-agencies. Such level of defiance called for

serious thought in approaching the subject matter. There was therefore the need to establish a deeper understanding of the African situation from the perspective of the Ghanaian society, not based on speculations and assumptions, but firsthand knowledge solicited from the ground, from the narratives of the people.

In the face of such complex and inherent problem, this study sought to gain a reasonably clear understanding of the situation. Even though this study was concerned with the manufacturing of technologies, which seemed to fall within the fields of manufacturing engineering, using conventional quantitative (statistical and mathematical modelling) research approaches were unsuitable for application here. A mixed research approach using qualitative methodologies was found more suitable, hence, adopted for this research purpose.

The methodology combination considered as the most suitable for this research purpose were: ethnography, grounded theory and case study. The fieldwork was mainly ethnographic in nature. Grounded theory provided the techniques for robust data analyses. The shea butter industry in Ghana was taken as the case study. It helped set the scope to better understand the attitude of the Ghanaian society towards technology creation.

It was also gathered from fieldwork and literatures reviewed how previous attempts to address the African technology issue only yielded disappointing results. To avoid repeating past failures, this study sought an approach which would allow the implementation of a development-intent to be culturally engrafted into the structure of society concerned. This approach emerged as a three-step methodological system also referred to

as the SIM approach (i.e. study, identify and model (SIM) the intended project).

The SIM approach, broadly speaking, was generic and deemed suitable for project implementation in a multicultural society like Ghana. This generic overarching three-step methodological approach, drawn from the work of Clemens and Dalrymple (2005), was aimed at establishing a sense of commonality for cultural assimilation, cutting across ethnic, cultural, social and political barriers.

8.4 Accomplishment of Aim and Objectives

Employing the above methodology combination and the overarching methodological approach to the study, certain features worth considering were identified from the Ghanaian society. These features were constructed into narrative of findings presented in Chapter Six of this thesis. The findings tended to provide an overall picture of the patterns formed by these features and their role in contributing to the status quo of the Ghanaian technology lag under discussion. These patterns are summarised in the findings below. It is gratifying to state tentatively here that, to a very large extent, the aim and objectives of the thesis have been met to a certain degree of satisfaction. This in coming out with a model for the manufacturing of the technologies. However, how the model will perform when implemented, forms the subject for a separate study elsewhere.

8.5 Findings

Among other things, this research found that the Ghanaian society was divided on cultural and ethnic grounds. There was also a clear dichotomy between the formal (modern Ghana) and informal (traditional) sectors, which are mainly urban and rural based respectively. These divisions were seen to inhibit social cohesion, as cross-tribal communication was minimal. This appeared to lead to non-proliferation and exchanging of indigenous technologies, hence, limited knowledge sharing across different cultures. The cultural variances divided the Ghanaian society into clusters of several "independent" enclave-states, hence, its multicultural/multiethnic feature. This feature was suggested to impact significantly on the history of Ghana's technology lag, and indeed, Africa at large considering its small market size.

For example, when compared to the industrialised societies, they were observed to be dominated by a major single culture, as in their language, at least, at the inception of the technological advancement. This conspicuous and ubiquitous difference tells a lot and should require further study elsewhere. Hence, multiculturalism in Africa verses monoculturalism in the West stands out as a prominent variance between both societies.

This is however not to argue that monoculturalism is required for development; it was simply highlighted here as an observable differential factor (which may require further studies). This study, on the contrary, saw the cultural variances as an African identity, which should be maintain as a cultural heritage in conformity with the sustainability concept for culture (see Section 4.4 of this thesis). The cultural divides may therefore be approached by

adopting a development path that identifies the point "where cultures meet" to create "a sense of commonality" as the vehicle to cut across cultural, ethnic and social barriers.

In addition to the cultural variances, it was also observed that the whole concept of economic development was relatively new to the Ghanaian cultural society (informal sector). Hence, there seemed not to be much endeavour, impetuous or inner drive (inherent competition) to develop the indigenous technological capability to enhance their economic background. This seemingly lack of instinct to improve on a cultural heritage in the rural setting was actually reflected in the governmental (formal) sector. There, policy makers and government officials, who partook in this research, were found to be vague on the issue of technology development and manufacturing in the country. Indeed, this research could not find any clear policy or framework in Ghana towards the subject of technology manufacturing or its development. The Ghanaian society as a whole was suggested not to be oriented towards the concept of manufacturing of technology. This was apparent in almost all the contact made during the fieldwork. The absence of manufacturing engineering as a first degree course in any of the tertiary institutions of technology in Ghana stood as a strong evidence to strengthen this observation.

The case study on the shea butter industry, among other things, also revealed that the Ghanaian society was not very keen on manufacturing the technologies needed by the local industry. Instead, efforts in research were devoted to increasing the yield of the shea fruit to obtain more nuts. It was found that existing nuts in the bush exceeded demand; hence the need for increase

in yield was not urgently needed. Seeking the means, as in developing a technology to add value to the produce was seen to be avoided.

In summary, there seemed to be a fatalistic attitude across the Ghanaian society towards the thought of manufacturing of production technologies. Based on such observation therefore, using the work of Sagasti (1992), as previously mentioned, a model was constructed that may be able to stimulate the society to the consciousness of its need for technology and confidence in its ability to succeed in technology manufacturing. Details of the model are provided in Chapter Seven of this these. A brief narrative of the model is however provided below.

8.6 The Technology Manufacturing Model

Using the SIM approach as a methodological framework, the Ghana Cocoa Board (Cocobod) was used as the template for the Model, referred to as the Ghana Manufacturing of Technology Model (GMTM). The Model consisted of a number of units, one of which was the board, called, the Ghana Manufacturing of Technology Board (GMTB) or the Board for short. The Model is masterminded by the Board, which serves as its brain. Other units of the Model included the manufacturing centres, research institutions and others. As previously stated, the model will operate a business model like Cocobod. The full business model for the GMTB goes beyond the scope of this study's limits. It is therefore set as the immediate future for effective implementation of the technology manufacturing model.

For example, Cocobod sources for quality cocoa beans from the farmers for onward sale on to the international market. Similarly,

the board will source for the manufacturing of the needed technologies from technology sources, such as the manufacturing centres, research and academic institutions, using the business community, the public and others as input sources.

The model was constructed to incorporate a full consciousness for the application of the sustainability concept. Any machine or component manufactured not deemed sustainable enough will be returned to the appropriate unit for correction. The concept of sustainability was, in this study, taken beyond its realms to include emphases for certain control in behaviours. Following is a highlight on concept as presented in this study.

8.7 Sustainability in the Model

The whole concept of the sustainability application in this study was viewed not only within current definition of "preservation", but was taken outside with emphasis on maintaining an attitude to discourage excessive indulgence and materialism. This included self-control in behaviours to curtail superfluous and ostentatious consumerism, even though that is what the market needs to flourish and create more demand for manufacturing to take place.

This study therefore advocated for the concept to incorporate a notion of self-control and discipline whereby an individual is encouraged only to acquire just what is needed, thereby, truly preserving a future for coming generations. Sub-subsection 4.4.2 of this thesis elaborates further on this.

The model was therefore constructed with a unit dedicated to trade and public engagement. Such engagement, was hoped

may have the potentiality to encourage extensive dialogue, exchanges of knowledge, cultural interpretations and relevant information in a constant changing world.

This study, attempting to address many issues within the framework concerning technology manufacturing, cannot claim to have accomplished all that was needed to be done. It faced its own difficulties and challenges. Some of the limitations to the study are highlighted below.

8.8 Limitations in the Research

This study, by and large, may be seen as considerably successful, especially when viewed from the level of the confusion that existed at its beginning. Though successful, there were a number of factors that leave more to be desired. For example, its concern was on Africa, but it was limited largely to Ghana only. Thus, its absolute applicability to the rest of Africa can therefore not be certified for the limited working data. This therefore leaves more room for further study to cover the wider African region for its applicability and adaptability.

The data collection phases went reasonably smoothly. There were however, instances where some respondents, after arranging appointment for interview changed the timing at the very last minute. This often led to hurrying the researcher during the interview. Such problem was however counteracted by making further appointments or making follow up calls using the telephone for further interview.

Also, being new to the field of research and in particular, the methodology employed, posed considerable challenges in

themselves. The researcher had to learn many new skills, especially components in the methodologies and interviewing techniques, within short period and apply them almost immediately. The lack of existing experience may possibly reflect in the thesis in some areas yet to be fully comprehended.

On the all, significant amount of experience was gained in the research period. In spite of the limitations, the overall research seemed to present potential significance to contribute to national policies and development plans for a developing country. This study, in general, seemed to have opened a way for developing economies to explore and exploit their technology manufacturing capabilities and this requires more work to be done. Future work in this area may take its own path of study that is yet to be defined or fully fathomed. Below is a brief construction of its perceived future features.

8.9 Future Work

Africa's manufacturing of production technologies and eventual development systems have been the general aspiration of this study, though focusing on manufacturing of production technologies. The model developed in this respect, was in retrospect, a transcendent vehicle needed to create that sense of commonality cutting across cultural, social and political barriers in highly multicultural African State, like Ghana. The ultimate picture this will lead to can only be momentarily envisaged in this closing session of the study.

This thesis is not exhaustive in answering the technology quest for Ghana. More work is therefore required. Nevertheless, this research work rather seemed to set the first step for a new

future study, here, in the meantime, termed, *Development Engineering*. Development engineering appears will cover a broader study area with its specificity to this subject in hand termed, Development Engineering in Manufacturing, or; Development Engineering in Manufacturing of Technology. Therefore, the general term may be; Development Engineering in X, "X" representing a subject area, e.g., Electrical Engineering, Civil, Construction, etc.

The overarching three-step methodological (SIM) approach may serve as the fundamental principle on which to build the Development Engineering concept. It was hoped that this concept may lead a way forward in addressing the long pressing African problem of technology underdevelopment to create wealth for the continent, and indeed, the rest of the world, since Africa may thenceforth contribute more significantly to the global economy.

The emphasis on sustainability practice in this study meant that increase in wealth should not lead to negating behaviours and unhealthy lifestyles among the population and authorities (as previously explained). There should be mutual respect at tribal, national and international levels with no oppressive abuse of wealth and power to intimidate any individuals or peoples. Equity and mutual respect for all humans should be the guiding principles irrespective of political affiliation, religious beliefs, or racial/tribal description.

Further work is also required in other fields like accounting, economics, sociology, geography, etc., to adequately analyse the new system to update their various theories to reflect the changes this new development approach may bring about. For

example, the system (i.e. the dynamics of the new technology development system) should encourage such things as trading by product exchange to reduce excessive reliance on the cash system (see sub-Subsection 3.3.2 and 7.6.1). An accounting method will therefore need to be developed to be able to capture the transactions. This suggests a modern form of trading by barter and will thus, require economic theories to analyse and explain its implications and complications in the modern world, while the sociologist may look at its social impact and other studies may also find their various niches of relevance to the new African development concept. The concept, when developed, may find its place of relevance in the human society of professional, business and academic world.

Development Engineering, as a possible future field of study, was conceived to lead to economic gains for the local businesses in the society. The development of the new programme may however, include certain pertinent fundamental tasks that may need equal attention. This constituted some of the following in terms of a future research agenda centred on Africa. These may include:

- The business and Implementation Model
- Empirical testing of the proposed technology development model; setting out a scheme to measure or a method to quantify the outcome of its operations.
- Conceptualisation of the model for theoretical discussions, analyses and further application.
- Critical review of the SIM Approach, i.e. the three-step methodology used in the study.

- Research into the educational setup for a structure geared towards technology development and use in local industry.

This study found that there was no clear policy in Ghana's development agenda for technology manufacturing. The current practice is for the industry to import all its needed technologies. A policy review with consideration for manufacturing of technologies for local industry was therefore seen as needed.

However, a more urgent and immediate future task for this study will be to develop the full details and workable implementation business model framework for the technology manufacturing model. This may assume the business model innovation (BMI) approach (Girotra and Netessine, 2014), a new concept emanating from the expansion of Operations Management, itself, an offshoot of Manufacturing Engineering. The business model will focus on building the strategic and competitive manufacturing of technology business model for excellence in profitability, sustainability and overall development. It may choose to do so, by first of all studying the Ghanaian business atmosphere to explain why certain key State Corporations and businesses poised to succeed rather failed. Examples of such businesses include the Ghana Airways, State Transport Corporation (STC), Ghana Food Distribution, Ghana Cotton Board and any other that may be found relevant to answer key questions towards the BMI for the technology creation venture for Ghanaian economy and Africa at large.

8.10 Implications for Policy and Recommendation

As also found in this study, Africanist scholars have shown how the issue of technology does not feature in the policy of African countries. Indeed, this study found that there was no policy for the manufacturing or provision of technology for the local industry in Ghana. It was surprising to even note that no tertiary institution taught manufacturing engineering at the first degree level. As a whole nation, the issue of technology for production seemed to have been left for investors to bring into the country.

In view of such obvious lapse, there is the urgent need for policy review in this regard of manufacturing of technology.

As a matter of factual, the evident absence of a framework towards enhancing technology in the country at the policy and governmental levels stands to strengthen the claim by respondents that technical education is undermined in Ghana. For example, the national educational budget for technical education was just increase to over 1% at the time of writing. And technical education was relegated for those deemed less intelligent students.

A policy drive is needed to reverse such mind-set; there cannot be a strong technology development intention (be it manufacturing of technology or whichever) without a technical background/workforce to maintain it.

Human intelligibility, within the framework of this study, could be split between technical mind and non-technical mind. It might therefore be worth stating here that the human society needs

both the technical mind and non-technical to spearhead the society to create a balanced and strong economy. The technical component, which, unfortunately, is undermined in Ghana, is indeed, extremely vital. For example, this study may ask; what on earth is not a technical outcome? To mention just a few: the automobile you drive is a technical outcome, the building you live in and all in contains are technical outcomes, the mobile phone you use is technical outcome, the computer you use, the shirt you wear, etc. are all outcomes of technical work. Virtually, technical outcome is concerned with almost every aspect of the human life. As such, it should rather be given a higher priority. Ghana, on a more serious note, needs to review its attitude towards technical and vocational education and practice.

This study therefore recommends that technical and vocational education should be provided to all the youths in Ghana, at least, between the ages of twelve to twenty in all schools. It should be taught in all the schools in the country as a compulsory subject.

Without the presence of a strong technical involvement, the model proposed in this study cannot work! Building a national technological base require technological minds and mindset. Hence, the utmost need to incorporate the technical mindset when drafting national policies.

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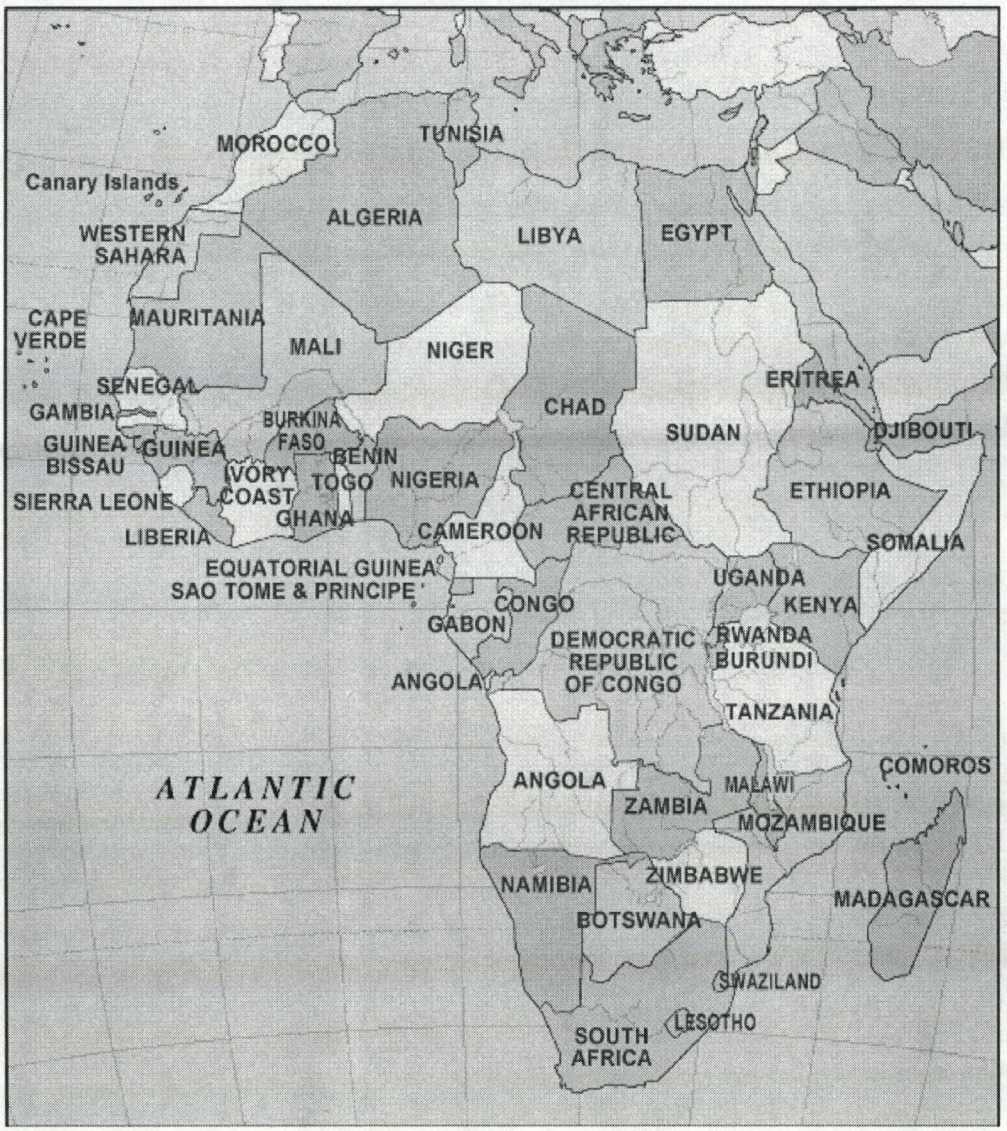
APPENDICES

Appendix One

Map of Africa and sub-Saharan Africa

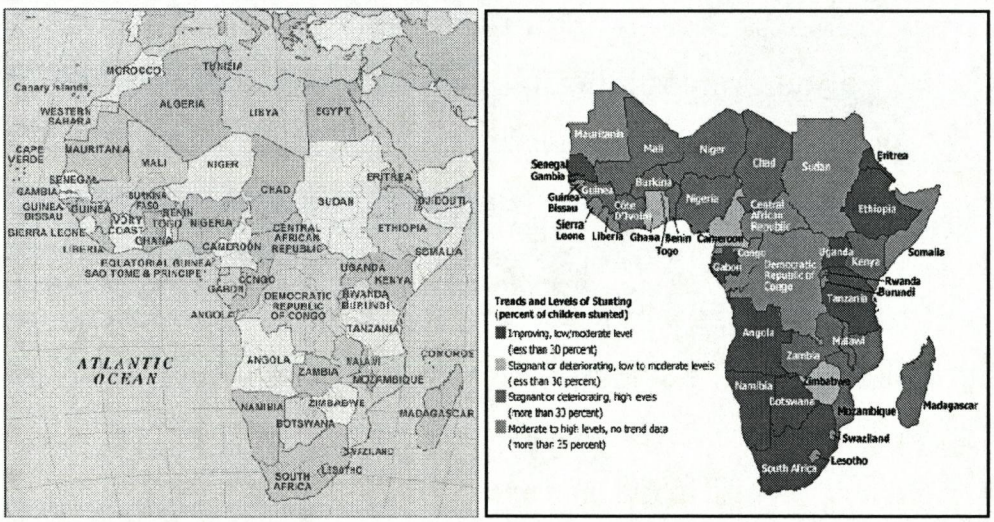


Map of all Africa (Source:

https://www.google.co.uk/search?newwindow=1&espv=)

Map of sub-Saharan Africa (Source:

https://www.google.co.uk/search



Figures showing Africa and sub-Saharan Africa

Appendix Two

Research Methodology continued from thesis

Understanding Research Paradigms Leading to the Choice of Methodology/ies

Approaches to research theories and practice have historically been broadly described as either qualitative or quantitative. The difference between the two, in simple terms, is data quantification for the latter and the former placing emphasis on words, a stance from a narrative perspective (Bryman, 2012).

Also, there is a traditional paradigmatic divide among researchers. Quantitative research, for example, is often seen as deductive in approach, claiming to belong to the positivist/postpositivist paradigm (i.e. epistemologically and scientifically based research approach), while qualitative research, on the other hand, often described as inductive, is considered as interpretivist and ontological in nature (Glogowska, 2011). The various philosophical assumptions that guide these research approaches are present in the research paradigms to which a researcher must align (Bryman, 2012, Greene, 2008, Mackenzie and Knipe, 2006). There has however been an age old antagonism among research scholars regarding the application and adherence to paradigmatic assumptions that underline a research approach, where researchers are expected to work within the confines of a specific paradigm (Datta, 1994).

Research practice, in recent times, has however been subjected to a considerable amount of reviews with a view to ending the

debates and tensions in research practice that have posed major challenges to social scientists (Morgan, 2007, Patton, 1988) especially those in the fields of nursing, education and evaluation. These groups of research professionals have been routinely using a diversity of [research] methods in their work because the practical demands of the context in which they worked called for both generality and particularity (Datta, 1994, Greene, 2008).

Thus, the notion of defining a research study as being qualitative or quantitative within a paradigmatic assumption is being challenged for a more *pragmatic* perspective which will have the flexibility and robustness to address the difficulty researchers face practically. In the face of this challenge therefore, a conforming concept of research will need to be defined.

Here, the idea of research will be taken as defined by Mackenzie and Knipe (2006), as thus;

> [A research is] *...a systematic investigation or inquiry whereby data are collected, analysed and interpreted in some way in an effort to understand, describe, predict or control* [a] *phenomenon or to empower individuals in such context* (Mackenzie and Knipe, 2006)-(pg. 194).

This systematic investigation is generally carried out within a secluded theoretical framework or guiding philosophy, which is sometimes referred to as a paradigm (Mertens, 2005, Bogdan and Biklin, 1998), as explained by Mackenzie and Knipe (2006).

A research paradigm, according to the authors, may be seen as the theoretical framework, as distinct from a theory, which influences the way knowledge is studied and interpreted. Indeed, Mackenzie and Knipe stated;

> *It is the choice of a paradigm that sets down the intent, motivation and expectations for the research. Without nominating a paradigm as the first step, there is no basis for subsequent choices regarding methodology, methods, literature or research design* (Mackenzie and Knipe 2006)-(pg. 194).

Such assertion by the scholars suggests taking the paradigmatic approach as the philosophical underpinnings that guides research methods in data collection, analysis and reporting. Generally, these underpinnings are ruled by certain assumptions that structure a paradigmatic position in its contextual application. The paradigms are characterised by the assumption of incommensurability or coherency as demonstrated by the work of Greene (2008). This therefore demands further exploration of the subject to position the state of paradigmatic concepts and approaches as pertaining to research methodology choice.

What is a Research Paradigm?

The concept of paradigm in research is highly influenced by the work of Kuhn (1970). Authors in social science believe that 'within the science studies, the consensual set of beliefs and practices that guide a field is typically referred to as a "paradigm"' (Morgan, 2007).

According to Bryman (2012), when Kuhn realised that scientific research was going through a revolution whereby an existing paradigm was increasingly being challenged by anomalies that are inconsistent with the assumptions and established findings in the discipline at that time. Kuhn therefore, explained that the

anomalies resulted in crisis in that discipline, thus leading to the emergence of a new paradigm to resolve the crisis (Bryman, 2012).

This therefore implies that paradigms, though incommensurable (Bryman, 2012, Greene, 2008, Kuhn, 1970), are not cast in stone, but hold the potential of forming new paradigms as the case may be. Bryman (1988) conveys an understanding of paradigm as, a grouping together of beliefs and dictates which for the scientists in a particular discipline, influences what should be studied, how research should be done and how results should be interpreted. Mackanzie and Knipe believe that paradigm is fundamental to a research; it sets down the purpose, motivation and expectations for the research. This stance tends to agree with Bryman's definition in the sense that both definitions portray 'paradigm' as constituting the philosophical guide on which a research could base its approach (methodology, method, strategy, etc.). Thus, the authors point out the indispensability of paradigm as a defining factor for a research type. However, research paradigms are considered to be fundamentally 'incommensurable', as earlier stated, and hence, incompatible (Bryman, 2012).

In addition to the understanding espoused by Bryman's definition of paradigm, several other perspectives have been raised by different authors. Mackanzie and Knipe (2006; pg. 194) have produced an array of views presented by some research authors such as: Bogdan and Biklen (1998) who defined 'paradigm' as *"loose collection of logically related assumptions, concepts or propositions that orient thinking and research"*, and Cohen and Manion (1994) who view it as *"the philosophical intent or*

motivation for undertaking a study". The work of Mac Naughton, et al. (2001), according to Mackanzie and Knipe (2006) give, "*a definition of paradigm which includes three elements: a belief about the nature of knowledge, a methodology and criteria for validity*". In the opinion of Mackenzie and Knipe (2006), these definitions provide a general scope of what a research paradigm could be perceived to be.

Mackenzie and Knipe went on to indicate that 'some authors [like Creswell, (2003)] prefer to discuss the interpretive framework in terms of 'knowledge claims; epistemology or ontology or even research methodologies' as given by Neuman (2000), 'rather than referring to "paradigms" '. In the author's take, some theoretical paradigms, which include positivist/postpositivist, constructivist, interpretivist, transformative, emancipatory, critical theory, pragmatism and deconstructivist are often used differently in different texts with varied claims. In fact, some authors strictly refer to these paradigms as philosophies while some others rather choose to align qualitative and quantitative research approaches to paradigms (Johnson and Onwuegbuzie, 2004). They maintain that these two paradigms, 'including their associated methods, cannot and should not mix' (Howe, 1988), thus, referring to quantitative and qualitative research approaches as non-mixing research paradigms. There seems to be confusion here among researchers regarding the use of research terminologies.

This mixing up of the use of research terms therefore suggests that the meaning accorded to 'paradigm' is not clearly defined. It is also probable that they are subjective to different author's interpretation, hence, their varied application and inconsistency.

They therefore lack a common definition. Below are a few examples which try to explain this further.

Sieving through Research Terminologies for Clarity

To some researchers, what denotes a paradigm is its philosophical assumptions to which researchers must align themselves without combining it with any other particular paradigmatic description (Johnson and Onwuegbuzie, 2004). For example, as understood from the scholars, the positivism purists define their approach based on rationalistic empirical philosophy, which are often epistemic scientific research methods and would not incorporate any divergent view of say, an interpretive paradigm which, is an ontological construct of subjectivity to realism (Angen, 2000). This rationalistic empirical approach involves quantitative data, i.e. use of figures for statistical analysis. And this approach is referred to by some authors as quantitative paradigm, while qualitative paradigm is guided by such philosophies as interpretivist/constructivist, realism, etc. (Johnson and Onwuegbuzie, 2004).

This two-fold 'paradigmatic split' of research into qualitative and quantitative paradigms is in contrast with the original line of usage by Kuhn (1970). The subsequent expansion and discussion of Kuhn's work by social scientists, have come to establish 'paradigm' as rather characterising the philosophy underlying research assumptions.

Following the definition given by Bogdan and Biklin (1998), paradigms specify the *assumptions, concepts or propositions* by which a research is conducted. Or as Cohen and Manion put it, it is the philosophical basis underlying a research approach. These

perspectives seem to be in better agreement to the line of original and expanding usage of the term 'paradigm'. Contrary to the misplaced usage of the term, the approach to data orientation (method of data collection and analysis), is here rather referred to as quantitative or qualitative research approach (Bogdan and Biklin, 1998).

From the discussion above, this study will therefore refer to the terms quantitative and qualitative, not as research paradigms , but as tools or 'methods of data collection, analysis and reporting' (Mackenzie and Knipe, 2006), or generally refer to them as research approach, while the term, 'research paradigm', would be reserved to mean the philosophies underlying the assumptions that guide the research. Also, in this study, the following understanding will be attributed to the following research terminologies: *research method* will be regarded as a technique for collecting data, e.g. interview, questionnaire, observation, etc. (Bryman, 2012,), and *research methodology*, which could also be referred to as *research design* (ibid), will signify 'the structure that guides the execution of the research methods' (ibid), i.e. 'the framework for the collection of data and analysis' (ibid). For better clarity, here are some examples of research methodologies, these include: case study, phenomenology, ethnography, critical theory, grounded theory and many more (Bogdan and Biklin, 1998, Bryman, 2012, Burns, 1997, Greene, 2008, Mackenzie and Knipe, 2006, Morgan, 2007).

Paradigm Shift in Research Practice

As earlier mentioned, the stand point of the argument to work strictly within a particular paradigmatic context has posed considerable disadvantage to researchers faced with a research

question, or the practicality of research work that demands a multiplicity of approaches (Johnson and Onwuegbuzie, 2004, Greene, 2008). In the light of such difficulty, *pragmatic* (Greene, 2008) and *transformative* (Weaver and Olson, 2006) research paradigms have emerged, allowing different research methods to combine, especially with the *pragmatic paradigm*, within a flexibility framework leading to a new research approach commonly referred to as *mixed-research methods* (Brannen, 2005, Greene, 2008, Johnson et al., 2007, Mertens, 2005).

These two paradigms were developed fundamentally without commitment 'to any one system of philosophy or reality' (Mackenzie and Knipe, 2006), but with focus on solving a research problem (Mackenzie and Knipe, 2006, Creswell, 2003) irrespective of which method to use, as to which paradigm it traditionally belonged to. The methods-combination approach should however not be confused with paradigm classification. According to the authors, a researcher would usually align philosophically with a particular paradigm, but based on the orientation of the theoretical framework a decision will have to be taken as to which method/s to adopt and combine (Mackenzie and Knipe, 2006, Mertens, 2005, Wiersma, 2000), thus, not necessarily aligning to one school of thought which maintains the incommensurability of paradigms.

Though scholars conform to the incommensurability of paradigms, Greene (2008) presents a set of six traditional paradigmatic assumptions, which 'refer to stances on the nature of the social world'. There, Greene presented 'various positions in the mixed methods literature on the sensibility of mixing paradigms or

mental models when mixing methods'. This was based on one of the paradigmatic assumptions, which states that;

> *Historical philosophical incommensurabilities among paradigms are reconcilable through new, emergent paradigms, such as pragmatism, scientific realism or transformation-emancipation* (Greene, 2008)-(pg. 12).

By this assumption therefore, the 'incommensurability' of paradigmatic approach that prevented researchers from working across paradigms and combining methods in research has been done away with. As such, paradigms can now be sensibly combined to achieve more realistic results from the research aim/s. This is seen as a major step in research approaches as noted by scholars (Greene, 2008, Johnson et al., 2007, Mac Naughton et al., 2001). Interestingly, this combination has a relatively long history of application, for example, in the work of Marcus and Cushman (1982) where the interpretivist paradigm was combined with the positivist paradigm in the reporting of the emerging aspect of epistemological ethnography described as experimental realist ethnography thus, making the argument for combination even stronger.

The coming of Mixed-methods as a Research Approach

According to Creswell (2003), as shown in the work of Mackenzie and Knipe (2006), research approaches have become more complex, but flexible in their application, with *mixed-methods* being more acceptable and common. Mixed-methods research approach is here seen as one which involves both numeric and textual data, thus, implying a combination of qualitative and quantitative research approaches (Bryman, 2012)-(pg. 268).

Mixed methods research is therefore seen as a distinct research approach commanding the same respect as quantitative and qualitative research approaches (Greene, 2008, Johnson et al., 2007, Mackenzie and Knipe, 2006). This therefore implies there are now three distinct research approaches, which are qualitative research, quantitative research and mixed-methods research (Greene, 2008, Johnson et al., 2007, Mac Naughton et al., 2001, Johnson and Onwuegbuzie, 2004).

However, it could be argued here that authors who classify mixed-research methods as the combination of quantitative and qualitative research approaches only do a disservice to the new research approach. Such a perception could be seen as rather delimiting and an incomplete representation to its full meaning and applicability. In fact, it could even be argued to be delusive on such grounds.

As can be seen from the ongoing discussion, *mixed-methods research* depicts a mixing of methods as deemed appropriate for a particular research question at hand. And this mixing is not restricted to research paradigm or any methodological tool for data collection, as such, the mixing could be; a combination of methods belonging traditionally to the same paradigm or a combination of methodologies instead (Tashakkori and Teddlie, 2008). By taking such a more inclusive view of mixed research, it should fit into the list of definitions provided by Johnson et al., (2007). It could be said here that *mixed-research* consists of a combination of methods, methodologies or even paradigm mix for the research purpose. By this therefore, mixed research should not be limited to qualitative and quantitative mix alone, but could be a mix within qualitative or quantitative, for example,

a research that uses both structured interviewing with structured observation or ethnography with semi-structured interviewing (Bryman, 2012; pg. 628) is a mixed-research though the combination is entirely within the qualitative domain. This seems to suit the *completeness method* of combination as shown by the author (ibid; pg. 637). Though the author's assumed default position is a quantitative/qualitative mix, it has been shown that the mix could be within qualitative only or quantitative as the case may be.

Critical Consideration of Mixed-Research

According to Brannen (2005), in an attempt to address a research question or set of questions, the researcher must devise a strategy. Mixed Methods Research (or simply, Mixed Research) suggests adopting a research strategy which uses more than one type of research method in the same project. As earlier described, researchers may need to negotiate a suitable approach as the need may arise (Creswell and Garrett, 2008, Tashakkori and Teddlie, 2008). Mixed-research advocates, like Johnson et al., (2007) and others believe, that the mix provides the researcher with a more versatile tool, resulting in a superior research, to address such challenges that are not normally possible with the mono-method research approach; it 'offers great promise for practicing researchers who would like to see methodologists describe and develop techniques that are closer to what researchers actually use in practice' (Johnson and Onwuegbuzie, 2004)-(pg. 15).

The idea of mixed methods research approach is however not accepted by all researchers the same way its advocates project it to be. Though many researchers see the advantages it provides,

others perceive it as an inferior approach that ignores the assumptions that underlie research methods and transforms 'qualitative inquiry into a procedural variation of quantitative inquiry' (Smith and Heshusius, (1986), as cited in Byrman (2012); pg. 629).

Mixed research critics contend that each research approach should retain its distinctive paradigm of operation, which has not been the case with *mixed methods*. Advocates, like Creswell (2003) as shown in the work of Mackenzie and Knipe (2006), insist that;

> *...it is unduly improvised research, which eschews the use of both qualitative and quantitative research approaches and that paradigms which overtly recommend mixed approaches allow the question to determine the data collection and analysis methods applied. That is, collecting both quantitative and qualitative data and integrating the data at different stages of inquiry* (Mackenzie and Knipe, 2006)-(pg.199).

The critics, in this regard hold a different view; for example, according to Bryman (2012), the embedded methods argument rejects such position, arguing that the decision to employ a particular method is not simply about data collection, but a commitment to a theoretical framework that ascribes to that method (Hughes, 1990). In other words, critics refute the concept of mixing methods of different research paradigms.

Here, Hughes seems to be preaching an allegiance to a 'system' irrespective of its practicability and deliverability; whether it works effectively or not. Such a position suggests or points to

stagnation of human development and shuts one away from seeking better ways to solving rising pertinent problems, hence, not being innovative in approach.

Indeed, the stance taken by critics to the general rejection of the approach is based mainly on the predisposed conception that different methods from different paradigms are not complementary, hence, the mixed research idea should be discarded (Smith, 1983). This position taken by Smith could be described as mistaken and unnecessarily harsh judgement, on the grounds that it does not take into account developments that have occurred in research theories leading to the emergence of the mixed methods. Indeed, bearing in mind the time of his publication, the benefits and full concept of mixed research was probably not yet tested and comprehended, as such, insecurity could lead to such harsh conclusion.

As earlier mentioned from the work of Greene (2008), paradigmatic research assumptions have been broadened to incorporate a 'pragmatic' paradigm whose assumption provides the philosophical base to overcome this problem of incompatibility. More so, still following on Smith's argument, the suggestion of discarding a research approach on the grounds that its constituent elements (research methods) are not complementary is suggestive to the oblivion stance of the practical difficulty faced by researchers. The difficulty inevitably hampers the progress of their work, hence, standing as a disadvantage to humanity in general.

It may also be said that the misconception of incompatibility, non-complimentary and incommensurability claim by critics is also about mixing of paradigms as it is with methods, thus,

arguing that 'in reality mixing is incommensurable' (Guba, 1985). This may be true at the time of arguments as research theories were still developing, hence, like Smith (1983) the full picture was not realised. Now mixed-research has come to stay (Johnson et al., 2007).

In conclusion, on the basis of the flow of the above discussion, this study views mixed-*research* in terms of the combination of methodologies rather than methods. This approach seems to provide the added advantage in that research description would be clearly visible by merely looking at the methodology combinations. For example, taking a *mixed-research* approach with methodology combination of Phenomenology and Grounded Theory immediately conveys a clear picture of what the researcher is about, though the methodologies combined may all ascribe to the same set of methods like interview, observation, discussion, etc. Each methodology has its distinct approach, as such, combining them as the *mixed-research* approach tells more about the work the researcher is doing rather than the methods which may be a common occurrence among the methodologies and on their own may not show what role they are playing. Thus, making reference to the methodology combination is better preferred for this study, hence, adopted.

Appendix Three

First and Second Fieldwork Interview Transcriptions

First Fieldwork in Ghana

Undertaken from March to July, 2011

All the contents including diagram and pictures were obtained from the fieldwork by me.

The focus of the interviews was to solicit information that will help in determining the Ghanaian mindset in relation to developing a system of technology to establish a sustainable manufacturing base in Ghana as a culture.

List of establishments where interviews were carried out

1. Palm kernel Oil Factory, Koforidua
2. Ghana Oil Palm Development Company (GOPDC) Ltd.
3. Village A, Upper West Region
4. Village B, Northern Region
5. UDS, Wa Campus, Wa
6. Driver and Vehicle Licensing Authority (DVLA), Ho
7. Customs Excise Preventive Service (CEPS), Ho
8. High Court Judge, Ho
9. Ghana Standard Board, Ho
10. Business Advisory Council (BAC) of the National Board for Small Scale Industry (NBSSI), Ho
11. Ghana Cocoa Board (Cocobod), Accra
12. Ministry of Finance and Economic Planning (MoFEP), Accra
13. Ministry of Trade and Industry (MoTI), Accra
14. Gratis Foundation, Wa

15. Shea Butter Factory, Tamale
16. Local Soft Drinks Producer, Ho
17. Shop Owner, Wa

1. Palm kernel oil factory

Interview with the women at the kernel oil extraction factory

A semi-structured interview in the form of discussion was carried out with the four women I spoke to at the local factory (see figure 1-1). The discussion was to obtain the women's perspective of their experience in their trade, mainly to identify the technologies used and they were obtained. See figure 1-2 for factory layout.

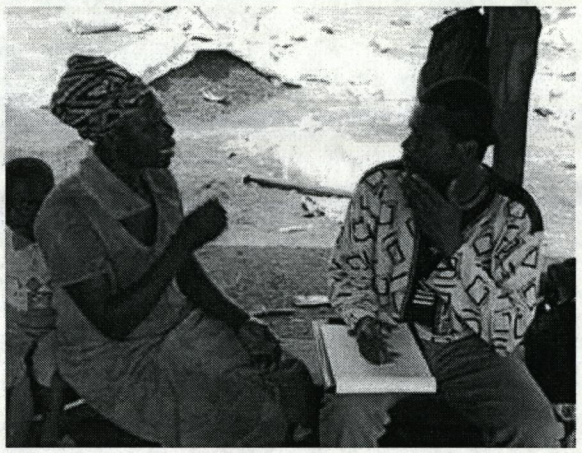


Fig. 1-1 Speaking with one of the kernel oil extracting women

Fig. 1-2 Palm kernel oil extraction factory layout showing a worker carrying a basin of water leaking out

Question1-1: When asked how profitable their business was? They responded, all speaking at the same time;

Answer 1-1: The work is hard, there is no profit; we do it because we don't have anything else to do.

Question 1-2: What makes your work difficult?

Answer 1-2: It is very difficult; we have to stand by the heat stirring the nuts continuously directly under the heat of the burning sun, even when it is raining, we cannot take cover otherwise the oil will spoil, we have to stand in the rain, stirring at the same while time keeping the flames burning while in the rain in the open air. Our work is very hard. We have to lift the sacks with the nuts ourselves; they are very heavy. Our arms get tired; we get very exhausted at the end of the day. "Mh", one of them sighed, "we are suffering", she said.

Question 1-3: Why don't you do the roasting under the shed provided instead of working directly under the sun?

Answer 1-3: Government made the shed for us to put our babies there while we work. We cannot afford the cost to raise one for our work. We would have liked to have a shed for each roasting stand, but there is no money; we don't make any money with this work.

Question 1-4: Do you have other known methods for making the oil?

Answer 1-4: No, we do know any other way to make the oil. This is the only way we know how to do our work. If you have an easier method, please come and teach us; we are suffering.

Question 1-5: Where did you get the training for this work?

Answer 1-5: Here. We were trained by our senior mother (pointing a finger at an elderly lady working a few meters away). We worked as apprentices for 3 years to qualify to be free to do our own work; we are free, we do our own thing now.

Question 1-6: Who are you customers?

Answer 1-6: We normally have specific customers we supply to. They are mostly local food vendors. If there is surplus, then we may choose to sell to outsiders, but we decide who to sell to.

Question 1-7: Wouldn't you like to expand your customer base?

Answer 1-7: We cannot; the work is too difficult. Two large sacks of the nuts only gives us about eight gallons of oil. We cannot make a lot.

Question 1-8: Do you have a leader here? How are you organised?

Answer 1-8: We do not have any leader. We work as individuals, we are not an organisation. Each person produces her oil and takes away her thing to go and sell.

[*I thanked them for giving me their time and attention. After a brief interaction I left to locate the Ghana Oil Palm Development Company.*]

2. Ghana Oil Palm Development Company (GOPDC) Ltd.

Interview with the GOPDC Respondent

A discussion with a Senior Offical as the respondent, took an informal pattern of interview to initiate discussions on the subject, which went thus:

Question 2-1: What does your company do?

Answer 2-1: We are an Agro-based company, specialising in oil palm production and production of palm oil. We are the largest oil palm and palm oil producing company in Ghana. We make different brands of the palm oil which ranges from the crude oil to highly refined cooking oil called 'olein', we also have the stearin. We even produce the crude palm kernel oil and palm kernel cake. Our products are used almost throughout the food and pharmaceutical industries.

Question 2-2: Who are your main customers?

Answer 2-2: It used to be Unilever only when we were then producing only the crude palm oil. At that time, the company was state-owned, but since its privatisation, and sa Siat nv, a Belgium company took over its management, they have diversified production into the various brands we have it today as I showed you. The new management refused to comply to the terms of Uniliver to sell all our crude palm oil to them only. Our various brands now go all over the world, but our main market is Europe. We sell to all, anyone and again most industries use palm oil for their productions; even the milk you buy from the market, they add a brand of our oil to it to give it that creamy

look and texture. Palm oil is very important, it is extremely versatile. It is a big market.

Question 2-3: Why didn't the State diversify production into the various brands you mentioned? Why wait for sa Siat nv?

Answer 2-3: I can only answer from my understanding and personal experience; you see, those days, Uniliver had the monopoly and tried to retain it, so whenever any government came up and tried to take control of production to maximise output for higher profit, Uniliver would simply warn that government in power that it will withdraw the production of its commodities like soap, etc, from the local market then the population will revolt. The government would then be made unpopular. So each government attempt becomes powerless.

Question 2-4: I understand this is an agro-based company, but you use machineries in your processes. Do you have any of your machines manufactured in Ghana or by a Ghanaian manufacturing company?

Answer 2-4: The shareholders managing the company are from Belgium in Europe, and so they take decisions where to get any needed machinery from. In Ghana, as I see we have attitudinal problems so much that I do not think we can convince them to find any machines produced here. We do not like each other, we are not united.

Question 2-5: In your opinion, why can't your management be convinced to look for machines manufactured in Ghana to buy?

Answer 2-5: Ghana is not known to produce machines and we do not have that recognition because we don't promote each

other. No one will promote your company. It is that same attitudinal thing I was trying to tell you about. We don't reward hard work, we prefer to give it to an outsider, the white man, than to a fellow Ghanaian who will come and dominate you. Take for example, our Entry Ports; they are so loose, our Immigration Staff do not check for working permit and qualifications when the expatriates are coming into the country. We need to build the right institutions, what we have, they don't work. See what is happening to the National football team, for example, they won't accept a Ghanaian coach, because he would have to be paid like the expatriate. Others feel he will get more than they have. We have problem.

[*I wish to apologise for any comments in the above response that tend to touch on racial sensitivities.]*

Question 2-6: Why do you think it is so, that Ghanaians do not promote each other?

Answer 2-6: I will tell you this on a personal basis; the simple fact is that an Ashanti man will not want the Ewe man to be his boss, likewise the Ewe man. The Dagomba man, Grushi, and the rest, no one will want the other to be his boss. Look at the political parties, see how they are divided on tribal lines; the Ashantis to one side and the Ewes to the other. No one wants the other to lead him.

[*I thanked him and we exchanged contacts*.]

3. Village A – 1st Remote Community Visited

I arrived at Village A with my interpreter to our arranged host's residence. He was warm and welcoming.

That same evening of the first day of our arrival, we were taken to be introduced to the Chief first before we could begin our work. This was their customary practise.

It was a pride and joy for our host to take us around the village, proudly introducing us to each family home as his quests. He would even boast to some of his clan mates (as was interpreted to me); he would say; "it was I they came to, they lodge with me at my house". He was a happy and affectionate old man who had the history of his family, clan and the whole village at his finger tip (see figure 1).

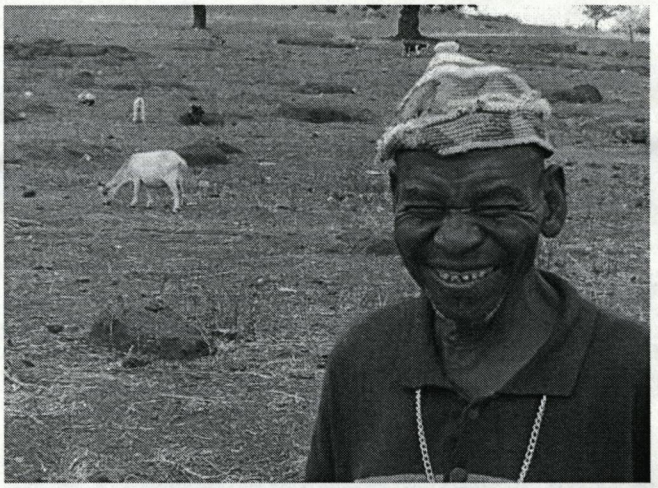


Fig. 3-1 Our kind host

Day two of our arrival, our host, now my main respondent, informed us he would take us along to attend an important meeting of all the communities of the village taking place at the Head Chief's palace.

Question 3-1: I asked through my interpreter; what time was the meeting scheduled for?

Answer 3-1: It is going to take place in the morning, whenever those expected to turn up do arrive.

We began heading for the meeting place just before 10 am, making a number of stoppages on the way receiving explanation to various features along the way and the landscape. We arrived at the meeting place at 11 am, few men sitting under a pair of overarching trees and sitting on various objects as seats ranging from sticking out roots of a tree, stone, plastic chairs or on the bare ground (see figure 3-2 below). Soon afterwards, the meeting started with what seemed to be a tribunal, as some of them were called out to answer questions. There was obvious sense of order, but no sitting arrangement.

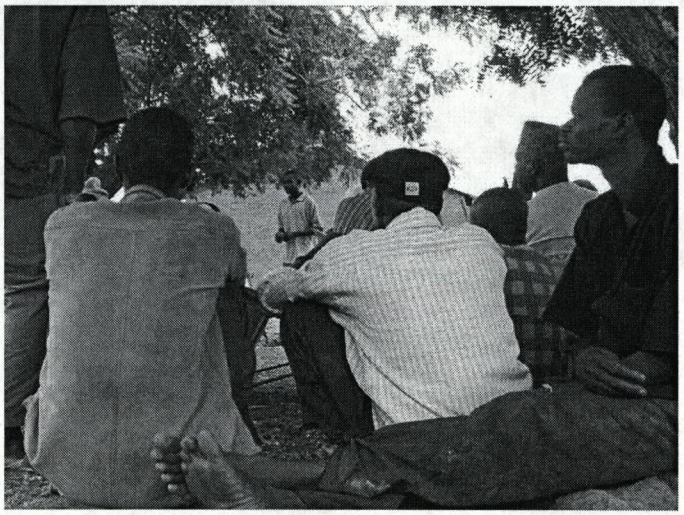


Fig. 3-2 Community meeting in progress

Upon enquiry, I was informed those called were being charged for not turning up for a communal developmental labour project of erecting poles for electricity. They received fines ranging from 30 to GH¢50 each. The meeting had not quite ended when our host politely interrupted the audience to introduce us and sought

permission to leave; to take round the village. We were warmly received and permission was granted him, so we left.

From the meeting, we were taken to visit their newly built health facility (see figure 3-3). The health centre project, I was told was financed by the Japanese Government. It was run by Community Nurses with serious cases being referred to the main Hospital in nearby Nandom or where appropriate. The Centre used solar to generate its electricity.

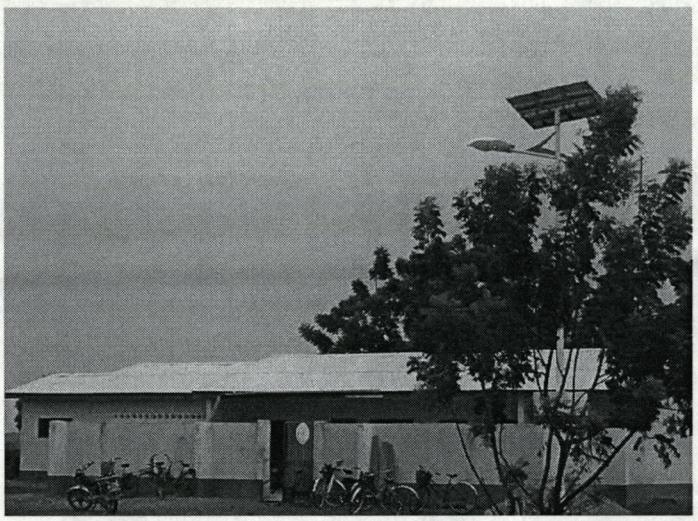


Fig 3-3. Village A ultra-modern health centre

This was quite unusual for a typical Ghanaian village. Interacting with the people and staff and the health facility, I asked one of the Nurses:

Question 3-2: You said you do not have resident doctors, but do you get doctors visiting periodically to see the patience?

Answer 3-2: No, nothing like that. The patients will have to find their own means to get to the Hospital.

Question 3-3: How far is the nearest Hospital from here?

Answer 3-3: It is quite a long way; it's only about 7 or 8 miles. It is quite a journey as you know we don't have cars here.

Fig. 3-4 Hill with stones for smelting iron (iron ore)

Opposite the Health Centre, our host pointed to a nearby hill (see figure 4); "you see those stones on that hill", he said, "our fathers used to melt iron from them to make hoes and arrow heads".

Question 3-4: Why don't you make iron from them anymore?

Answer 3-4: The good stones containing the iron are finished. Those you see there will have no good quality iron. But now we have lots of iron on the market. That job was very hard and we do not know how to do it anymore these days.

Our host went on; "You see that mountain faraway over there?" pointing to Southward to a range of mountains about 5km away (see figure 3-5), "there are lots of gold there. The Kussassi tribe knows all about gold. They climb up the mountain after every rainfall to collect gold".

Fig.3-5 Distant mountain range said to contain gold

Question 3-5: Why do you let them alone have all the gold; why don't you Dagara people go for some as well?

Answer 3-5: No, we are farmers, we don't do gold. We don't know mining, they know it, they know it. We the Dagaras don't deal in gold.

The following set of days, our host took us to visit various families. Each day, each family we visited was busy with one form of production or the other. These ranged from processing different types of food or oil to pottery and textile. Remarkably, only women were engaged in all the production as we noted. We also noticed that our host, in introducing any family to us, would always trace the family lineage to link with his, showing they were related. Invariably, every family in the village was related to each other as we were made to understand. It also appeared to be an important thing to do to them to show relationship with a family.

Figures 3-6 to 3-11 below shows some of the various productions we were taken to view:

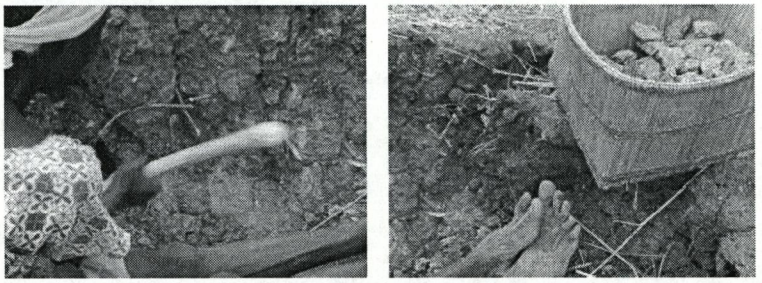


Fig. 3-6 A woman digging out clay for pot making

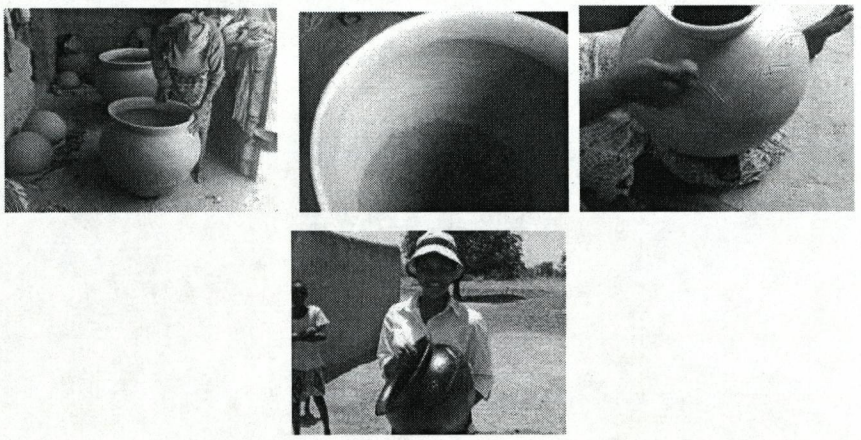


Fig. 3-7 Pottery making

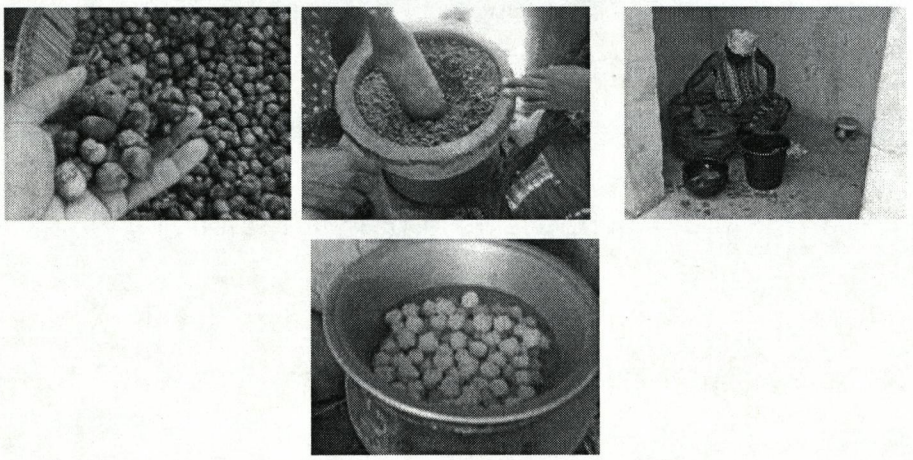


Fig. 3-8 Various stages in the production of shea butter

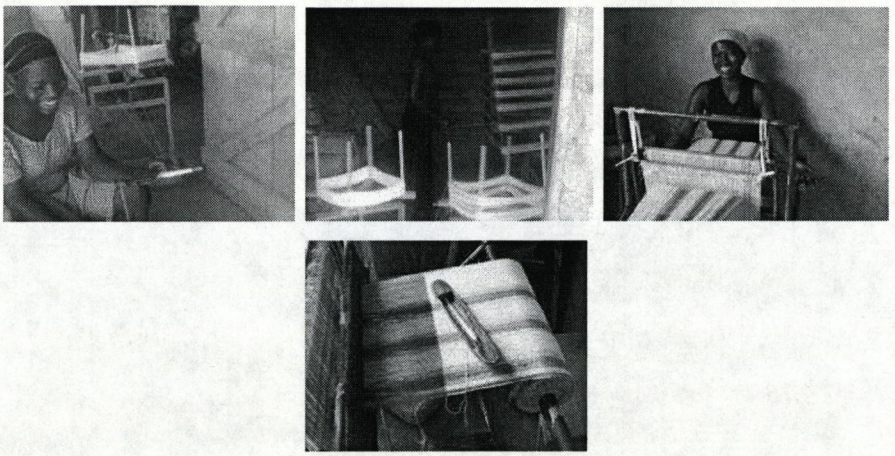


Fig. 3-9 Textile weaving what is called 'Dagara waja'

We also visited the only primary school in the village. Like the health centre, the facilities at the school were remarkably unusual for a village school. See figure 3-10 for a section of the of pupils sitted in a classroom.

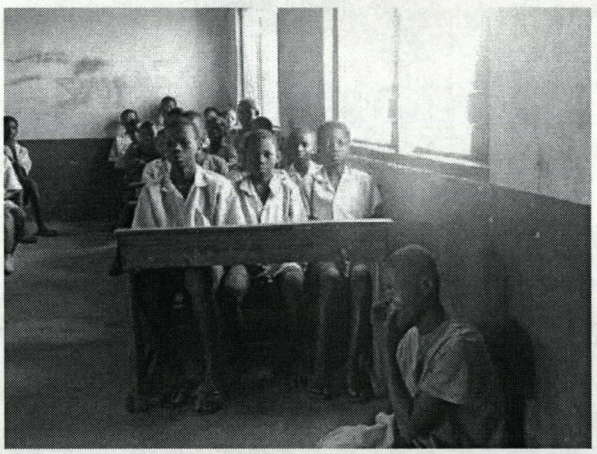


Fig. 3-10 A Primary School classroom with pupils at Village A

After the rounds, which took about five days, I was wondering what the role of men were in the society; so I asked our host the question;

Question 3-6: I see all the work is being by women; so what do the men do?

Answer 3-6: We do a lot; we protect the women when there is a war and we farm a lot with the women helping to do the planting. We also build the houses and do all the wood carving. We carve the stairs we use to climb to the top of the house called 'garu'. 'Garu' is very important to us; long ago, when the men were out in their farms and enemies attacked the village to take captives into slavery, the women and children would climb up the 'garu' and pull up the stairway to the top of the house. The enemies would look into the house and find no one then leave. But these days, we use it mainly to dry our grains away from our animals and we sleep on top of the house during the hot season when the rooms get too warm to sleep in.

See figure 3-11 (left) for a house owner standing on the 'garu' to mend part of the house. The carved wooded stairway can easily be seen leaning on the wall. The figure to the right shows a wood carver carving a hoe handle.

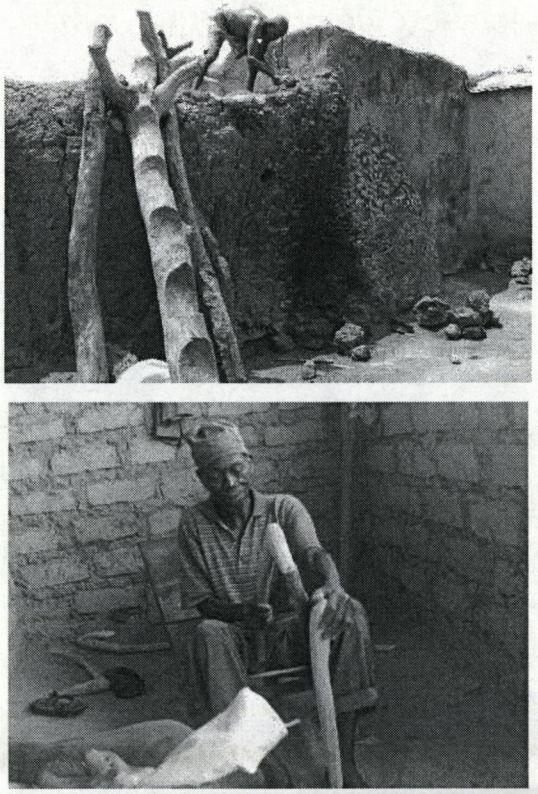


Fig. 3-11 House mending and wood carving

[*Our time at Village A ended after a week. We were thankful to our kind host and left in search of another society removed further away from modern technologies. This took us to Village B*]

4. Village B – 2nd Remote Community Visited

Our next destination from Dahile was Kompieni, where we gathered should be one of the few remotest communities left in Ghana. There too we were well received and attended to by our host. As their customs demanded, we ought to be introduced to the Chief before we could begin any work, otherwise, we would be taken as strangers and could be suspected for anything. I was happy to meet the Chief (see figure 4-1 for my interpreter and I posing with the Chief).

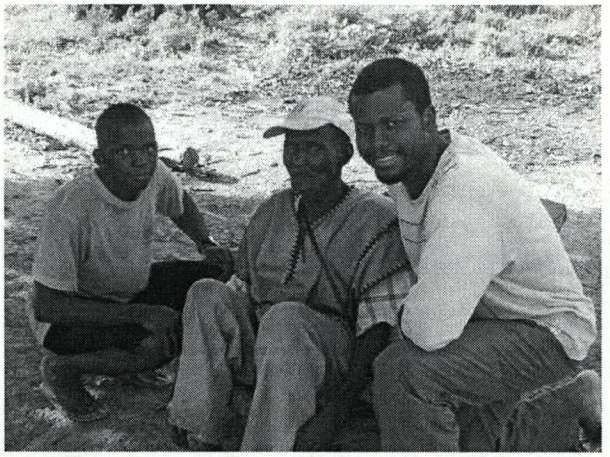


Fig. 4-1 Posing with the Chief Village B

Our new host, a respected Elder of Village B, alongside with three fellow Elders of the Community and his son, as the interpreter (since my accompanying interpreter was not fluent in the local language, being a different dialect), explained their historic and traditional production processes to us in a series of discussions and interviews.

Prior to the interviews, I accompanied my host and his family to their farm, though they would not let me work in spite of my insistence. Their full time job was farming and they used very basic tools such as hand held hoe (See figure 4-2 (left) for example of a hoe and how it is used (far right)) to do all their soil tilling and weeding and machete, commonly called cutlass used for chopping down stems and felling trees. The hoe is basically made of a metal plate that digs into the soil with a wooden handle.

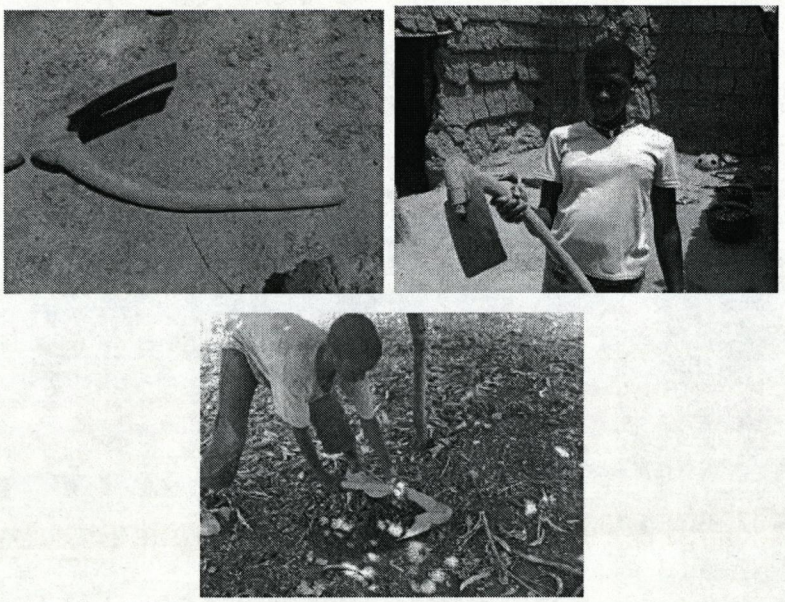


Fig. 4-2 Example of the hoe and demonstrating how it is used

In the series of interviews, I tried to find out from my host how they made (manufactured) their tools; because until very recently (last two decades), they essentially produced virtually everything they needed to use. As such; they were very conversant with all their ancestral production methods. So I began to ask;

Question 4-1: How do you make the hoe you use?

Answer 4-1: He simply pointed one in my direction and added; "it is made of this metal plate fitted into the wooden handle, sometimes, we use a ring to fit the wooden handle in instead of a pin".

Question 4-2: How do you get the metal for the plate?

Answer 4-2: These days, we just go to the blacksmith and buy it from them, but in the past, we would have to heat a particular kind of rock in the fire to give us the iron, which we could then

beat into any shape we wanted and use to make hoes, pots, arrow heads or jewels for our war heroes or brides.

Question 4-3: Why did the practice stop? Was it because what is on the market is better than what was produced then?

Answer 4-3: No, the iron my fathers produced in my childhood was better than what we have on the market today. The work was very difficult and involved lot of heating. Some of the iron produced was sometimes bad, just like a hard rock, but most of them were much durable than these ones we now use for making our tools.

I requested my host to recollect the smelting process and narrate it to me, he agree and added that he would invite some of his friends to come along in case he forgot any part the process. So almost every evening when he returned from the farm, together with his friends, we would go through one narration after the other. Thus, the interviews with the Elders covered the following areas:

- Iron smelting
- Bow and arrow making
- Mode of transport
- Method of documentation
- Trading of artefacts with outsiders
- Farming method
- Their culture and tradition

There was also an interview with my host's wife regarding in relation to the processes of shea butter extraction.

See figure 4-3 below for one of such evenings of interview with the Elders.

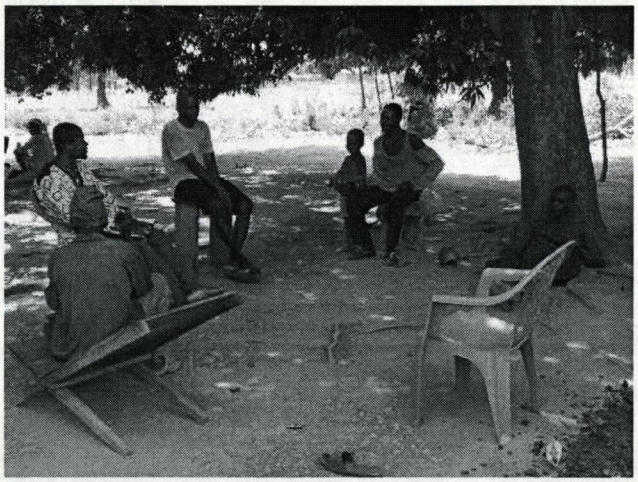


Fig. 4-3 One of several interview sessions with Community Elders at Village B

- **Iron smelting**

Question 4-4: How did you produce Iron traditionally?

Answer 4-4: Our fathers made iron from some particular kind of rock called 'Bensa-kwansibe'. Those days, there was no match; they make fire by striking two stones together over dry cotton.

The rocks were heated in a special fire (furnace) place called 'Saab'. It is different from the one used in the kitchen; they used very hard charcoal in the 'saab' to heat the 'bensa-kwansibe' rocks.

The heat in 'saab' was kept high by pumping air into it. The air is pumped using two earthenware pots. The pots' top opening are covered with animal skin firmly tight around the neck, but not stretched (billow). Each pot is fitted with a long stick in the leather covering the top opening. The stick has to be in the centred to the hole. An additional hole was made on the side of each pot. Moving the sticks in an up and down rhythm, air is pushed out of the side holes through two earthenware or

bamboo tubes into the fire. For good quality iron, the right 'bensa-kwansibe' had to be used. See figure 4-4 for diagrammatic illustration their smelting furnace.

As the heat increases, iron comes out like liquid from the rocks. It hardens up as it drops.

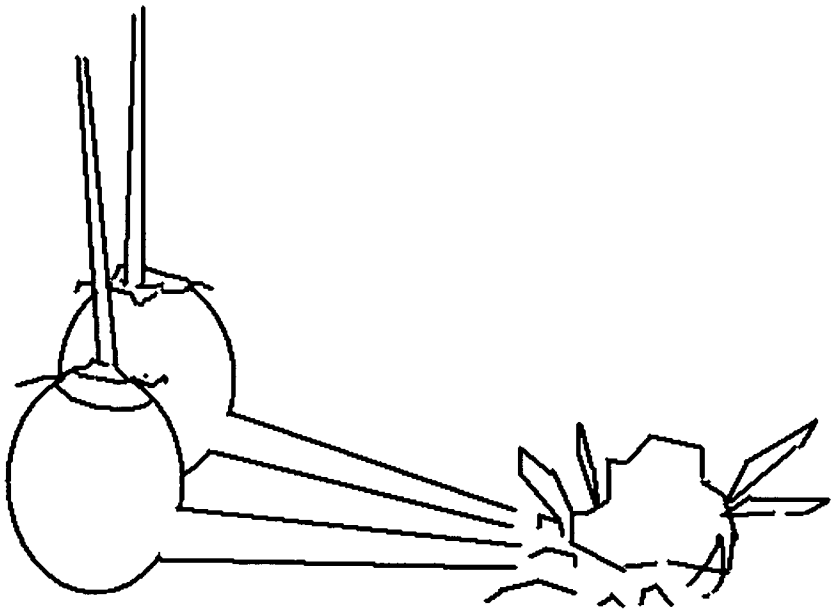


Fig. 4-4 Description of an Iron smelting furnace used by the Brifors called 'saab'

Question 4-5: What quantity can be produced using 'saab'?

Answer 4-5: They could produce only little at a time, but when they have large quantity of 'bensa-kwansibe' and more prople around, a number of furnaces could be setup and more people pumping the 'saab' (the furnace). Setting up is easy; just charcoal and the bellows.

Question 4-6: Compared to the current iron you see on the market, which your blacksmiths use to make the hoes you use; what was the quality of the old production?

Answer 4-6: The quality is determined from the type of 'Bensa-kwasinbe' that is used. When high quality iron is needed, only those special 'Bensa-kwansibe' are selected into the furnace. Their qualities are much higher than what we use today; they are strong and withstand any material when used as an axe or war helment.

Question 4-7: Do you know anywhere where iron is still produced this same way?

Answer 4-7: No, now we only have blacksmiths. Things have changed a lot. The blacksmiths even now take money, no more foodstuffs or animals like goats or guinea fowls.

Question 4-8: Did your fathers produce other metals apart from iron?

Answer 4-8: No, we only made iron.

- **Bow and arrow making**

Question 4-8: Do you still use bow and arrows a lot?

Answer 4-8: Yes, we use it a lot. It's perfect for hunting; it does the job better than a gun. The arrow head can fly further than the bullet. Huge animals like the buffalo a lot of times would run away with the bullet inside them, but with the arrow, they can't go far.

Question 4-9: Apart from hunting, where else do you use the arrow?

Answer 4-9: These days we don't fight wars anymore, but in my fathers' days, it was one the main weapons of war. We also use it today to protect our homes against enemies and wild animals.

Question 4-10: How do you make the bow and arrow?

Answer 4-10: There are different types of bows mainly according to the tribe. We call it 'tam', the arrow is called 'pii' and the sheath for the arrows is called 'lorh'. The Dgara people make theirs differently from ours; we make ours from a particular type of resilient plant called 'va-ur'. And the string is made of 'tanir', an extract from the 'dawadawa' (African locust bean (*Parkia biglobosa)*) tree.

'Va-ur' is specially treated with extract from other plants and heated to further strengthen it. The treatment period could take up a year. So the stick cannot break by pulling the string.

We use animal skin to make rope called 'tangama' to strap round the the 'va-ur' for a good grip.

Question 4-11: How long does it take to make the arrow?

Answer 4-11: It takes about a week to get a set done, when all materials are collected.

Question 4-12: Do you engage in any form of competition using the bows and arrows?

Answer 4-12: Yes, we compete a lot; we compete for best targeting and the bow that can shoot the longest distance. Those with bad bows go back to make it better.

Questions 4-13: Does your village compete with other villages?

Answer 4-13: No, every village does its own thing. We don't go to compete with anyone, neither does anyone come to compete with us.

Question 4-15: Can you differentiate your tribe's bow from other tribe's?

Answer 4-15: O yes, it is very easy. Every tribe has its mark on their bow. We can't miss it. They use different plant. It is easy to identify.

See figure 4-5 for a Brifor Elder demonstrating the use of the bow and arrow.

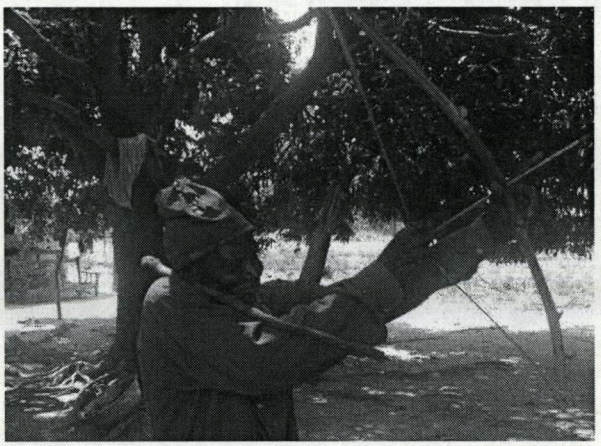


Fig. 4-5 A Brifor Community Elder demonstrating the use of the bow and arrow

- **Mode of transport**

Question 4-16: What has been your mode of transport?

Answer 4-16: Walking. We always walked to anywhere we wanted to go to until now that we have lot passenger vehicles. Our fathers took three days to walk to Wa for their market. We use canoe on the rivers. We carve it from the trunk of a big tree.

Question 4-17: Do you use the wheel to do any work?

Answer 4-17: We do not know wheel, we don't have wheel, we don't use wheel for anything. It was not known to us those days. Our fathers never used wheels in any way; we just walked all the time.

- **Method of documentation**

Question 4-18: How do you keep record events in the Community?

Answer 4-18: Within the Community, we select young men with good memory and make them recite whatever record we want to keep. We never lose any part of information; we tell it to the younger ones, and it carries on like that.

We also tell stories of our past. They are not just stories, they are our records.

We are illiterates; we don't know how to write, but we use white clay or charcoal to mark on the wall to count the number of pots of cowries lent to a friend or the number of days for the hen to hatch its eggs.

We collect a number of stones (pebbles) to countdown, by removing a stone out each day out of the counted lot to keep

track of dates for an upcoming event, when we will be expecting a visitor or for a market day.

Question 4-19: When a child is born, how do you know the time of birth after several years have passed?

Answer 4-19: The old women don't forget; they remember the time by relating it to something that happened then and tell how many days before or after that event the child was born. Also, we use the position of the moon and stars to keep track of seasons, dates and time; when to start planting, date for a festival.

For example, in those days, it took three days to walk from Kompieni to Wa, our fathers will use the night sky to determine what time to start the journey so they could arrive at a certain time of the day when the sun would be at a particular position, say, right over head.

- **Trading with outsiders**

Question 4-20: How was trade done with foreigners like the Arabs or Europeans?

Answer 4-20: We never traded with foreigners. Only our young men travel to the Ashanti land in search of part time work, but we do not trade with the outside world. They come to us and whatever they liked, they took away, but we don't trade with them. We take whatever they give us.

Question 4-21: Do you trade with your neighbouring tribes? In what do you trade?

Answer 4-21: Sometimes, our neighbouring tribes, like the Gonja people, can come and buy our cows or grains, but we don't trade much with our neighbours. We produce what we need for ourselves. When we need money, we take some of our produce to the market to sell to whoever would come and buy.

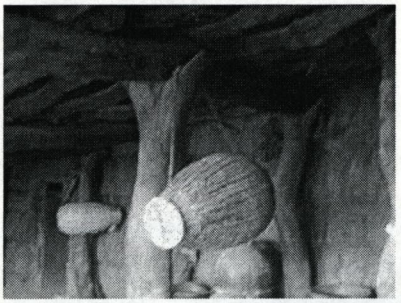
Question 4-22: What kind of things do you produce do you produce and could sell at the market?

Answer 4-22: We make everything we use and they are all things people come to buy from us at the market.

[*Some of listed items include the following]*:

- Larh – axe (for chopping wood, felling tree, carving and fighting war)
- Kwoso – an oblong basket for transporting livestock like chicken and guinea fowls
- Gbenjirr – opened top basket
- Jar – hammer
- Chaber - pliers
- Vrua – pin for making a small hole in wood
- Farfu-jupira – iron helment to protect the head during time of war
- Nyanpira – breastplate made from iron for war
- Welle – whistle to communicate with hunters and warriors
- Dakoh – chair or stool (carved)
- Koh – table (carved)
- Jilli (or jill) – xylophone, etc, etc, etc.

See figure 4-6 for some examples of Brifor artefacts:



'Kwoso' (basket) 'Welle' (Hunter's whistle) 'Jilli' (Xylophone)

Fig. 4-6 Pictures of some Brifor traditional artefacts

Question 4-23: Do you have specialised people who produce your textiles or is it also common knowledge like the shea butter processing?

Answer 4-23: We don't do textiles. It is the Dagara people who introduced us to it; we used to use animal skin to cover or the back of a special plant. We peel out the back, beat it on a flat rock into a fibrous texture and it comes out like clothe.

Question 4-24: How long ago were your fathers still using animal skin to cover as clothing?

Answer 4-24: Not long ago. It was in the last regime of Rawlins's government that we were introduced to clothing as we wear them today. A prominent tribesman living in one of the big towns worked hard to bring us to attention of government.

- **Farming method**

Question 4-25: I see you use the hoe and cutlass to do your faming; do you sometimes use animals to help you plough?

Answer 4-25: No, we don't use animals to farm anymore. In the past our fathers used animals a lot to plough the ground. They knew how to train the animals; they would normally use two bulls carrying a yoke to pull a plough. They owned big farms those days, up to between 20 to 30 acres of land. They had lot of techniques. We have lost it all.

Question 4-26: You seem to have all the knowledge of your forefathers' farming techniques, why do you say you have lost it all?

Answer 4-26: No, we do not know it anymore. We can't farm 20/30 acres like that these days. And now we are being given chemicals to spray our farms and fertilizers, but they are not actually very good for us; the crops go bad early in the storage, no good. No good, but we keep on using them. The companies come from Accra and make us farm for them. Sometimes they don't pay us. Other companies come; they do us the same thing.

Question 4-27: Do the chemicals harm your farms?

Answer 4-27: We don't know, but we think so. We do not know what will happen to our children and their children. Now we are old, we do not have the strength to farm and our children have all run away to Kumasi and Accra; that they are going to look for work to do. They like the big towns. There is no job here, only farming. It is hard work. They don't like the farming, they want to do something else, but this is what we have.

Question 4-28: Why have you stopped farming like that now?

Answer 4-28: I don't know why it all stopped. Our children don't like to stay in the village anymore. They all run to Kumasi to look for work. See, the village is now empty. Some of them do not even want to come back again. They say there are no jobs here.

Question 4-29: How much land do you farm now?

Answer 4-29: The size of someone's farm depends on the size of the family. Those with very big families can farm up to 10 acres.

Question 4-30: Will they farm all the 10 acres using the hoe?

Answer 4-30: It is normally done as a communal activity, where friends come to help and he also goes to help them on theirs. It is the hoe we have, that is what we use, but these days, sometimes government brings a tractor to help plough, then we pay when we harvest with some of our produce. Government also brings some people who bring us chemicals to spray on the weeds. They also, we pay them with part of our produce for the chemicals, and they also take our crops and bring us the money later, but three years ago they came and took the crops from the house while we were in the farm and they never returned again to pay us. They left a letter at our door, but we cannot read. We took the matter to the Police, but they say nothing to us.

Question 4-31: Have you tried to follow up on the Police again?

Answer 4-31: Yes, but they don't tell us anything, they just waste our time when we go to them. They know because we are

villagers and "we do not know book" we can't do anything and we too, we don't know where to go to.

- **Culture and tradition**

Question 4-32: What is your traditional way of preserving your culture?

Answer 4-32: During harvest, we have a festival where we perform a particular type of dance, called 'Kwabene'. There we use a different kind if 'jilli' (xylophone) called 'Bo-jill'. During this festival, we stress on our culture, mainly in the dance, song and the music. In addition to this, our daily lifestyle is based on our culture all the way. We tell our children stories for them to know our past and they take part in whatever we do, such as fishing, style of farming, songs, dance, everything we do we involve them.

Question 4-33: Do you have any set of rules or procedure by which you introduce new ways of doing the things you do, like making Shea butter or iron smelting, even the songs you make?

Answer 4-33: We do not have rules like that. The way we make the things we use is what we learnt from our fathers and new types of music and songs are introduced to replace old ones to perform the 'kwabene' dance. The winner is rewarded with a drinking-size calabash full of Shea butter. How we produce Shea butter is the process we know of; the history behind it has to do with two rival women, one of which stumbled on this process by accident when the other was intending to be cruel to her. We maintain the processes we know handed down to us by our fathers; we do not know any new methods.

Question 4-34: Do you have any form of exhibition where you showcase your productions?

Answer 4-34: Yes, we have a competitive exhibition called 'Luntah' where the farmers bring their products for display, the blacksmiths bring their works and all other people bring whatever they produce including bow and arrows, pots and everything. A winner is selected for each product.

Question 4-35: Do other villages get involved in this competition?

Answer 4-35: Every village does its own thing; they do not come here, we do not compete with anyone. The exhibition is only for our community.

Question 4-36: How do you spread your culture to other societies?

Answer 4-36: Visitors come to see our culture; we do not go out to them, we just live our lives as we have it. But we do travel to other places to look for work.

Question 4-37: How do you relate with other cultures around you like the 'Gonja', 'Walah', and 'Lobi' people?

Answer 4-37: We are different people as they are; they speak different language so we do not relate very much with them, but we sometimes intermarry, which happens rarely. We trade with them as well, but not very often; we trade guinea corn, payment used to be with cowries, but it is not very common anymore, so we use cash.

[There were other discussions and interactions that were not recorded. I was grateful to the Elders; I thanked them for their kindness and time given for the interviews.]

Shea Butter Processing

My host's wife at Kompieni No. 2 after taking me through the process of Shea butter making (see 'Ethnographic report on Developing Manufacturing Technology in Ghana; study taken from the Dagara and Brifor people of Northern Ghana' for full process of Shea butter making) had an interview with me (See figure 4-7). Below is the interview discussion.

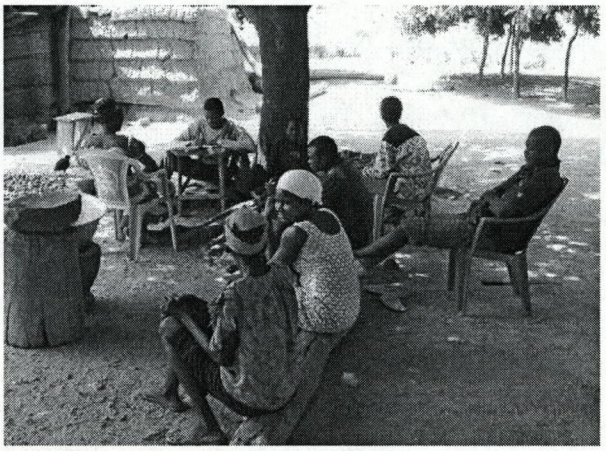


Fig 4-7 Taking interview relating to Shea butter processing and product

Question 4-41: You have told me all the processes involved in shea butter making; does everyone in the village now how to do it this same way or there are other ways of making the butter.

Answer 4-41:All the women know how to do it, even a little child. Every house can make the butter. It is our job as women. Every woman has to make her own butter for her family.

Question 4-42: Why don't the men make some of the butter too?

Answer 4-42: No, men are not allowed, it is a woman's job. A man cannot do it. These days, men know how to do it, but they are not welcome, in fact, in the past, men were forbidden and not allowed to touch it when we are preparing the butter. It was a taboo; if they did, the process was believed to have been defiled and will have to go through purification process. Nowadays we don't have that taboo anymore, but it is not a man's job so they won't do it, though they may know the process offhand.

Question 4-43: Do you enjoy the work? I mean doing the extraction.

Answer 4-43: You see, my son, it is very hard, it is a hard job. We have no choice; we are suffering. Apart from leaving the house at dawn to go into the bush to collect the nuts, it goes through all those long boiling and drying processes I described to you. We use a lot of firewood to do the boiling and firewood is now difficult to find in the bush. We need to go far to search and if you go into somebody else's land, it is trouble. We can't also buy; it is expensive and we don't even use just any kind of wood, we need the hard type that will burn throughout the night. That alone is not all; it takes the whole day for us to roast, grind and beat out the oil. You saw it for yourself? One person cannot do it. And we don't get good price on the market, they don't even pay at once; they take it on credit and pay when they want. You see this one (Showing me a ball of the butter, smaller than a lawn tennis ball) is only 40p (Ghana Pesewas), which is equivalent of

less than 20p (UK Pence). The work is too much, we are suffering.

Question 4-44: Have you thought of any other way of making the butter?

Answer 4-44: That is how it is done; that is the only way we know, except for the illegal process by adding some particular kind of leaves to it while boiling. The effect of the leaves artificially increases the volume of the butter and reduces the quality when it is finally prepared. You can't tell from the look of it, but when you melt the butter for use, you will then discover a large drop in quantity. If you do not know much about shea butter, you can never tell. That one is not good. No, we don't do it. Everybody here knows it and if you do it to a stranger, the stranger will never come back to you again. That is not good for us.

Question 4-45: Would you say the process is tedious?

Answer 4-45: Shea butter extraction process is a tedious work. It is very tedious and dangerous as well. Sometimes we even pick up snake in the darkness of the dawn without knowing. So our tradition is never to empty the nuts from the bush straight into the room. First, we pour out the content of the basin in the yard, spread it out before collecting the nuts into the house. It is very tiring; see, mixing the whole day from morning till evening for only this small quantity of oil (which should measure approximately two litres). My arms ache me through the night, sometimes for days before the pain reduces. We are forced to use the grinding stone; when we send the nuts to the town's grinding machine, it sometimes takes up to three days for it to

get to our turn, and the charge for the grinding is all the money I can sell the butter for. The machine in the town is good, but too expensive for us to use.

Questions 4-46: How much time do you use in the process? That is, time taken from collection of the nuts to complete butter preparation.

Answer 4-46: When the weather is perfect, that is when there are no rains or cloudy days, after collecting sufficient quantity of nuts from the bush, which can take up to two days, we dry them for about two weeks. We need two days to pound, roast and pound the roasted nuts again in the muter. And it takes us the whole day to grind that container *(pointing to basin that could contain up to 10kg worth of shea nuts, by my estimation)* full of nuts crushed in the muter.

Question 4-47: What tools do you use in the preparation of the butter?

Answer 4-47: We use:

- Gbal (pot, pan, basin) to collect the nuts from the bush. We use a different type to boil and roast it.
- Vurr (stirrer) to stir while roasting in the pot.
- Ŋmann (calabash) for taking out the nuts fetching the oil or even water.
- Tour and Tulu (muter and piston) to pound the nuts into smaller pieces.
- Nier (the base griding stone) and nibirr (the crushing stone for the grinding).
- Be'ela (scraper) to remove sticky bit on the grinding stone or in the muter.
- Davaraa (long stick) for cracking the nuts when dry.

- Kuoh (water) for boiling and washing and removing the oil from the paste
- Dagbora (firewood) as fuel to make fire to boil and roast the nuts

Question 4-48: Things like firewood and water are God-given, but how are the other tools like Gbal (pot, pan) and tuor (mutter) made?

Answer 4-48: We have people who specialise in making those things. We place order and they make them, like the 'tuor' and 'tulu', they carve wood from particular tree trunks. We give the carver yams or bowls of guinea corn in exchange, but now we can use money too. As for the 'gbal', in the past, it was all clay-made, but now we buy metal ones from the market; they last longer. The clay 'gbal' are used to store drinking water and local bear and other drinks. It keeps your water cool and fresh.

Question 4-49: What would you want the machine to do for you in the butter processing?

Answer 4-49: The grinding and mixing are so hard. We want a machine that can grind and mix the paste till the butter is all out. But they will charge us so much for the machine, we can't use it.

Question 4-50: Have you thought of the other side of a machine; that it can be dangerous? And your children might not know how to produce the butter the way you know it.

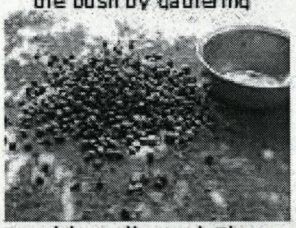
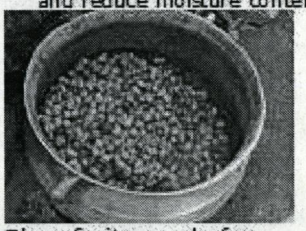
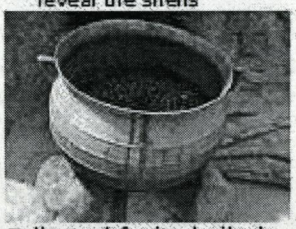
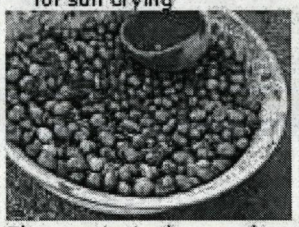
Answer 4-50: I think some parts are dangerous; I see how some parts move very fast on the machines used in the town. But if you are bringing us one, you will show us how to use it and we will do what you say, so we won't spoil the machine or let anybody get hurt.

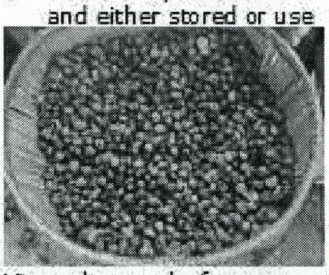
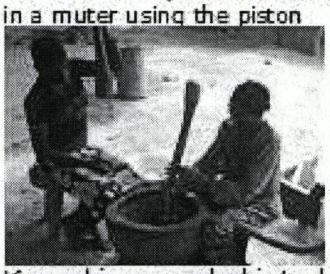
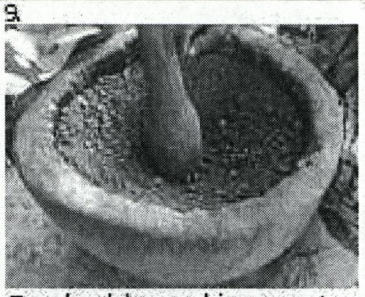
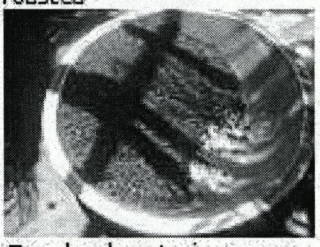
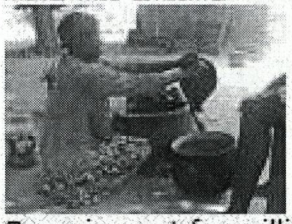
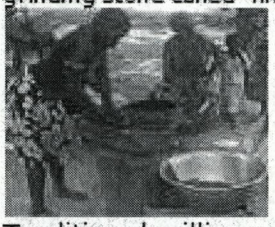
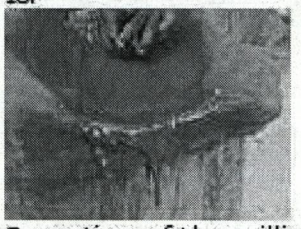
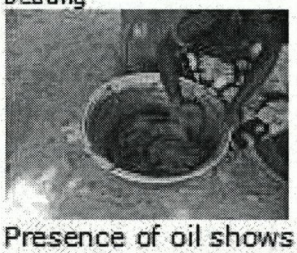
Our children cannot forget how to make the butter, we will teach them. They already know how to make it. And when we use the machines, I can make money to send them to school so they will also learn how to make more machines for us. We will be so happy.

[*I thanked her for the time spent.*

We were later informed that the whole Community considered us as their visitor; so gifts were brought to our host in support for our upkeep – a sign of their community bond.]

Pictorial representation of Shea butter extraction process at Village B

<table>
<tr><td colspan="3">The following steps (in order of numbering) is the process used at Kompieni for making Shea butter. This process was found to be common knowledge</td></tr>
<tr><td>1. Collect Shea fruit from the bush by gathering
 
Freshly collected Shea fruits</td><td>2. Boil the fruit to cook the nut and reduce moisture content
 
Shea fruits ready for boiling</td><td>3. Boil using hard firewood for long period, clean fruit to reveal the shells
 
Collected fruits boiled overnight</td></tr>
<tr><td>4. Spread out cleaned shell for sun drying
 
Shea nuts to be made dried</td><td>5. Dried nuts are either stored with shells or as kernel
 
Dried nuts are collected on rooftop called "garu"</td><td>6. The nuts are beaten with stick to break shells to remove kernel
Picture not available
Kernels are separated from shells, further dried and used or stored</td></tr>
</table>

7. Further dry the kernels and either stored or use  Kernels ready for use	8.Crush the dry kernels into bits in a muter using the piston  Kernel is pounded into bits	9.  Crushed kernel in a muter
10.Remove crushed nuts from the muter to be roasted  Crushed nuts in a pan	11. Roast the crushed nuts by heating and continuous stirring in the pot  Roasting over open heat	12.Roast until it turns into paste; sign of the oil in the butter  Crushed nuts turns into paste
13.Further pound the crushed roasted nuts into paste  Three pistons pounding	14.More than one person pounding makes it faster  Three ladies pounding in a muter	15.Pound until it turns very wet  Pounded nuts now flows
16.Scoop out paste from muter into container  Scooping out for milling	17.Mill into fine paste using the grinding stone called "nierr"  Traditional milling setup	18.  Operation of the milling stone
19.Continuous mixing and beating of paste to separate the fat  Mixing and beating paste	20.Mix and beat until surface of past turns oily, add warm water and continue mixing and beating  Presence of oil shows on paste	21.Paste turns whitish, increase mixing action adding cold water  Butter forms, ready to separate

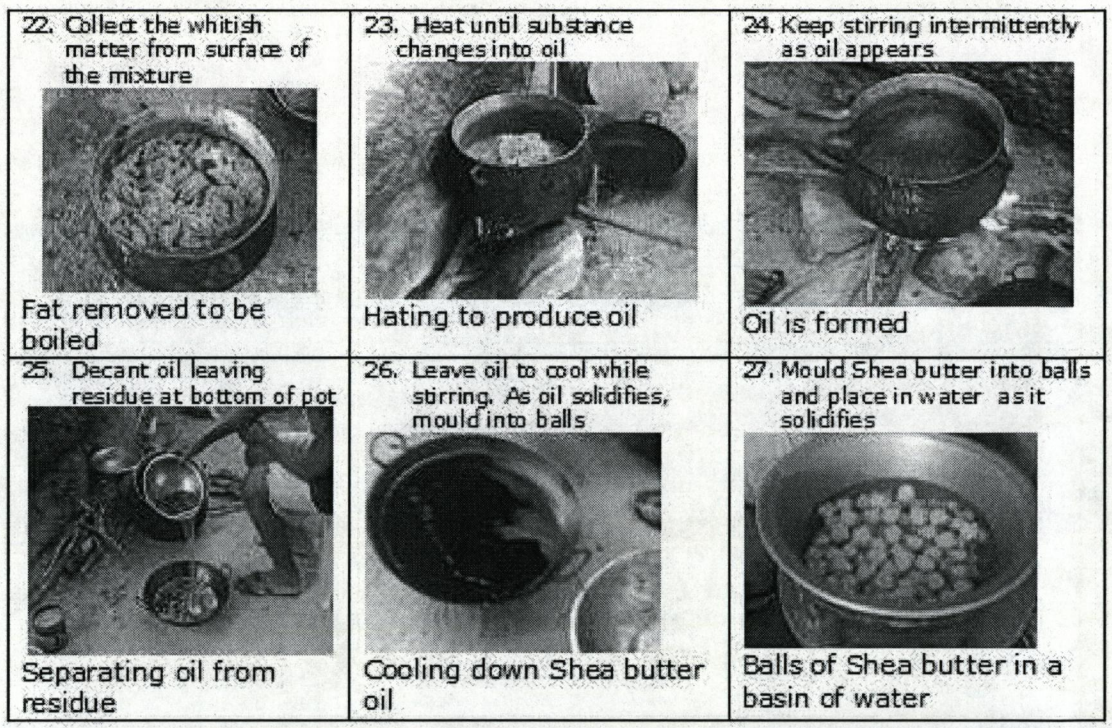


Fig. 15 Process of making Shea butter at Village B

5. University for Development Studies (UDS), Wa Campus

Having ended my stay at Village A and Village B, I visited the University for Development Studies, Wa Campus, to interact with officials there to ascertain the University's developmental plans and activities in building up manufacturing in Ghana. There I met with the Dean-in-Charge of the Faculty of Integrated Development Studies (FIDS), who welcomed me and accepted to take the interview.

Question 5-1: This is the University for Development Studies; can you please tell me exactly what that means?

Answer 5-1: We are centred on bringing development to the poor communities, especially in Northern Ghana. We do this by the method of teaching we adopt and send the students out on an outreach programme to spend part of their trimester with a

particular community. We give them guidelines on what to do and look for. We don't just send them like that.

Question 5-2: Do your students work at improving the processes these communities use to make their products?

Answer 5-2: We are mainly concerned with the social impact on the lives of the rural people; we do not interfere with their lives. Our students only look at the social aspect of their livelihood, how they benefit from development and how it impacts on their lives.

Question 5-3: Does the university have futures plans to consider the role of engineering in the development studies programme, particularly the aspect of sustainable manufacturing?

Answer 5-3: To the best of my knowledge, the issue of engineering has never been brought up. As I said, our concern is on social factors; how development affects the livelihood of those living in the villages. We want to contribute to make life better for the poor. That is why we send our students on the outreach programme to make these students aware of the life of the poor people. Some of these students have never been to a village before, so they have never experienced the poor people live, but now, when they graduate and in their employment, they can be sympathetic towards the village life.

Question 5-4: What vision is the university pursuing in the long term?

Answer 5-4: Our vision and mission statement are there on our website. Just check them out for yourself, it's; www.uds.edu.gh/; that is the vision we are following.

[*I thanked him for the time and promised checking on the website*:]

This was what I found from the site:

Vision

The University is envisaged to be a Home of World Class Pro-Poor Scholarship. This is reflected in its motto: "Knowledge for Service" as well as its methodology of teaching, research and outreach programmes.

Mission

The UDS seeks to achieve its vision by:

1. *Promoting equitable and socioeconomic transformation of communities through practically oriented, community based, problem solving gender sensitive research, teaching and learning outreach activities.*
2. *Providing higher education to persons suitably qualified for and capable of benefiting from it.*
3. *Positioning itself as a national asset in the facilitation of lifelong learning.*
4. *developing its information and communication technology infrastructure as the driving force for the education of more people, more rapidly and the improvement of efficiency and academic quality in order to advance community and national development*

Source: UDS Website (**www.uds.edu.gh/**)

6. Business Advisory Centre (BAC) of National Board for Small Scale Industries (NBSSI), Ho Office

The BAC of the NBSSI helps small business start-ups so I thought it worthwhile going to see the in charge. He was very happy with my research area; that that is what Ghana needs for its development agenda. I thanked him for his appreciation and we started the interview:

Question 6-1: So why do you say Ghana needs the study on 'developing a sustainable manufacturing system'?

Answer 6-1: The study is very important, because Ghana has lost the triangle of development; it is absent in Ghana. Development is a triangle like this (see figure 6-1 below):

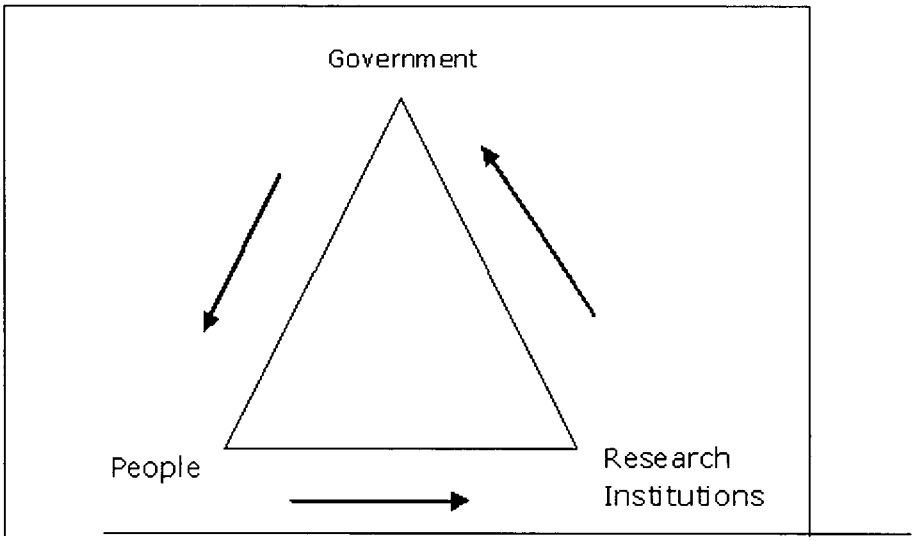


Fig. 6-1 A respondent's idea of a national development triangle.

With Government at the top, it should be receiving directions from research institutions for the benefit of the people. But what we have now, our politicians think they know it all and do not consult with the right body of knowledge. They only want the money.

See, because they do not consult, they undertook a project in village and went and dug a borehole for a community. After a year, they discovered the villagers refused to use the borehole; they were still drinking from the guinea worm invested lake. Why will the villagers abandon clean water borehole they have been

asking for? Government ignored any research and went on with the project without input from the supposed beneficiaries. The villagers say the borehole was located on an old cemetery and it is against their customs to use water from such a place. You see what I am saying, that is a total waste. Planning cycle is absent from the Ghanaian Nationality. Government needs to involve the people in policy making, but this is not so.

Question 6-2: What kind of businesses do you help people to setup? Are some of them engaged in any form of manufacturing?

Answer 6-2: We support mainly small enterprises, which can range from the tailoring shop to different types of production activities.

Question 6-3: Those your clients involved in some form of production, do they get their machines and equipment locally manufactured?

Answer 6-3: Every machine we have in Ghana is imported. We do not produce those things. That is why I was telling you about the triangle; we've lost it. I know of only one engineering company, but they produce agro based equipment. These are heavy metal equipment. Apart from that all we have are imported.

Question 6-4: What do you suppose is responsible this our inability to make our own machines?

Answer 6-4: It is simple my brother. It will stop the politicians from having their ten percent. They call it kickback. Each time they import anything, they get ten percent for their own pocket. You want them to lose the money? They will always go for their

ten percent. That is all the reason. Simple. Self-gain. That is the reason. Some people call it corruption; I call it 'kleptocrats'. They only think of their pockets, not what is needed for the country.

[*A lot more were said which I could not take down. I thanked him for taking part of his precious time and I left.*]

7. Ghana Standard Board, Ho Office

Visiting the Ghana Standard Board, Ho Office, I met with the Regional Officer who was particularly pleased with the 'sustainability' component of my work after I had introduced myself and my mission to him. I started by asking him to brief me on what they do as a standard board.

Question 7-1: Could you please tell me what your establishment does as a standard board?

Answer 7-1: We basically see to keeping of standards throughout the country. We can ask operations to stop in any company where they are not keeping to standards. We have standard requirements for various products and processes. We have some equipment in there (*pointing to a door across the room, which he later took me to view*) to test the petrol sold at the various filling stations for adulteration. We give standards to iron rod specifications, food packaging and processing and anything really.

Question 7-2: In the food packaging and processing; what standards do you set for local producers?

Answer 7-2: Generally, we specify that stainless steel should be used in all food processing and before any producer can have our

stamp of approval for certification, they must meet our requirements.

Question 7-3: On your requirement for the use of stainless steel, what if a Ghanaian engineer designs a food processing mechanism from wood, due to the high cost of steel and the design works well, will it be considered and accepted?

Answer 7-3: Well, such provision is not explicitly set down, but if we are able to test to see that the wood is not poisonous and will have no any harmful effect on consumers of the product, I am sure it can be approved. It will have to go through a test process.

Question 7-4: Do we have the machines and equipment for the food processing manufactured in Ghana and what do you check for to see if they meet your standard requirement?

Answer 7-4: I am not aware of any being produced in Ghana. A lot of those we meet, like the sachet-water packaging machine, they are mostly brought from China. And whether they meet our standards? Well, we see what they bring and if it is acceptable, we allow them to use it.

Question 7-5: What are some of the difficulties you have in seeing to standards being kept?

Answer 7-5: A lot of times, people do not comply and whenever we want to take the law against them, these politicians come and talk pleeeenty (plenty) and at the end, we can't do anything. I am only waiting for my retirement; I am fed up with them. They don't allow us to do our work, they allow all kinds of things to be brought in from China and Dubai. We are developing

standards, but we have no strength to enforce them as should be.

Question 7-6: Would you attribute part of the problem to the fact that we are not able to produce most of these machines ourselves here in Ghana?

Answer 6: I would agree with you, but it is mainly the selfish end of our leaders that is letting us down. I think the major problem with us in Ghana is that we do not know what we want, so we have nothing to work to. Look at the whole nation; we don't know what we want, so anything that comes into the country we like it and we go for anything ourselves. Now that I speak with you, we can't specify any standards for the automobiles brought into the country; if you choose, you can even bring in a right-hand-drive car, which was not the case. As a country, we don't know what we want.

[*I thanked him for the generosity of his time and went to enquire about what is expected for a motor vehicle in Ghana to meet registration requirements.*]

8. Driver and Vehicle Licensing Authority (DVLA), Ho, Volt Region

At the DVLA, I met the Regional Licensing Officer, who did not appear very comfortable with my coming. I assured him the interview session will be brief and should not contain sensitive issues. I also told him where he did not feel like responding to a particular question, he was absolutely free not to address it. He then allowed the interview and so I began:

Question 8-1: Wheat does your Office, as per the laws of Ghana, require of an automobile before it is deemed fit for registration?

Answer 8-1: When they bring in the car or any vehicle, we have a Customs Officer attached to this Office whose job is to verify that all the import duties have been paid. Based on the Custom's document, registration can then be done.

Question 8-2: So does it mean without the Customs affirmation of import duties being paid, a vehicle cannot be registered?

Answer 8-2: No it can't. By law, the Customs Duty must be paid.

Question 8-3: That implies a vehicle must necessarily be imported into the country, otherwise it cannot be registered? What if the car is made in Ghana; how do you go about registering it?

Answer 8-3: We don't make cars in Ghana. If anything, then you will need to find out from the Customs Office.

Question 8-4: In this Information Age, an individual could make a car at his backyard; does that mean he cannot register and use the car in Ghana even though it meets all your requirements for roadworthiness?

Answer 8-4: As I told you early, it could be compounded by the Police, because it will be illegal. There is no part of the law that allows such a vehicle to be legalised. You can't register it. I think the Customs people might best tell what one can do in such a case. So you might need to inform customs before building the car otherwise, you cannot register it.

[*I thanked him very sincerely and left for the Ghana Customs Excise and Preventive Services, Ho Office. There I was attended to by two Customs Officers who welcomed my mission, though they were time pressed to see to the funeral of one of their colleagues.*]

9. Custom, Excise and Preventive Service (CEPS) Ho Office

At the Customs Office, discussion took the following order:

Question 9-1: I have been informed that before a car can be registered in Ghana, it would have to pass through your Office for import duties to be paid; what happens then if a company sets up to manufacture cars in Ghana or an individual sets to build a car by himself?

Answer 9-1: As you have rightly been told, before a car enters into the country, there are certain duty charges set by Government to be paid by the importer. Even if it is parts of the vehicle or machines or even machine parts that are brought into the country, they will have to be identified by their chassis or unique identification number for duty purposes.

In the case of a vehicle being made in Ghana if the manufacturer brings in the parts and only puts them together here, the import duties paid on the parts brought in can be used to allow for registration. But if the vehicle is manufactured from scratch here in Ghana, then the Ministry of Roads and Transport will need to look at it to see if it meets requirements. In this case, they have to make the laws for it and set the requirements by law. I don't think we have any requirements like that yet.

Question 9-2: So at the moment, what happens if someone goes to the Transport Ministry requesting to register his home-made car?

Answer 9-2: Well, the person would have to battle it out with them or wait until such a law comes into effect. Now there is nothing in our laws that allow such for locally made vehicles as far as I know.

Question 9-3: From your experience dealing with machinery imports, what range of machines are generally brought into the country?

Answer 9-3: All kinds of machines, anything you can think of; from medical equipment to classroom teaching materials. We do not make anything in Ghana, you know. We import all our machines. I don't know what our universities are doing, our engineers are can't do anything. We don't even make bicycle tyre.

[I thanked them and left to find out what the Ghana laws had for manufacturing in the country, or engineering in general. The point of call was the High Court where I met with one of the Judges.]

10. High Court Judge at Ho

The High Court Judge had people waiting to see him, but allowed to see me where I assured him it would be a brief discussion of enquiry into the laws of Ghana that promotes engineering activities, with particular interest in manufacturing. The idea was welcome and began to place my questions to the 'law master'.

Question 10-1: What laws do we have in Ghana to promote engineering activities in the country?

Answer 10-1: We do not have any single law like that for engineering; what we have are in bits like the Free Zone Act, which provides some incentives to encourage investment in bringing in machines for various purposes. We also have the Export Promotion Council, Export Development Investment Fund (EDIFund) and others. All these were enacted into various Acts to serve as incentives for investors to bring their machines to promote local production geared towards export. But we are not seeing the outcome as expected.

Question 10-2: What, in your opinion, could be the reason for us not being able to catch-up to meet our production expectations, seeing even the collapse of all state-owned protected production systems of early governments?

Answer 10-2: It is difficult to point to one reason, but generally, it is a thing of the mindset; our mindset as a people does establish efficient production systems in the society. I think if we have a change in mindset, then we will able to keep our systems going without they collapsing.

Question 10-3: Apart from the laws to promote productions for export and encourage investments, what does the law provide to boost local manufacturing?

Answer 10-3: Manufacturing needs the machines, but do have them; we would need investors to bring them in for the local manufacturing you are talking of to take place. If there are any laws for manufacturing, I am yet to research into them. I don't

know of anything specifically for manufacturing or engineering. I am not sure if there is one as yet. You see, it is when we have a case we research into the laws. I haven't searched that line yet.

[*I thanked him for his kind attention and time taken.*]

11. COCOBOD, Accra

At COCOBOD, it was difficult to find an official to speak with me to make the initial contact, but eventually, I was sent to the Human Resource Manager who was prepared to take the interview after a long wait. I made him aware of my research area and placed my questions to him:

Question 11-1: As a Human Resource Manager, could you please tell me if you employ engineers and which area of engineering do you involve most here at COCOBOD?

Answer 11-1: We do employ engineers from different fields, particularly electrical and mechanical engineering graduates. But we do not keep them here; they are sent to the Technical Unit at Tema where we have all the machines.

Question 11-2: Can you describe the kind of work they do at the Technical Unit?

Answer 11-2: I can't tell exactly what they do; that is left to their Technical Officer. But generally we know they are meant to keep the machines running in good shape and the electrical systems. We expect them to be in charge of keeping the processing ongoing reducing breakdown frequency. I know they deal a lot with boilers.

Question 11-3: The machines they maintain in good shape; do we have some of them manufactured here in Ghana?

Answer 11-3: I don't think so; I don't think we manufacture any of those machines; these are huge machines, we can't make them here.

Question 11-4: From your experience, why do you think we cannot manufacture the machines we need, at least some of them?

Answer 11-4: We need to produce more engineering graduates in the country. The universities and polytechnics should make engineering courses more attractive so we produce more graduates. I think the entry requirement is too high and they are not given any incentives. If we want to develop as a nation, we need to give more attention to their training. The perception we have in Ghana is that those who attend technical education are less intelligent, but that is wrong. Technical education is very important for national growth.

[I *thanked him for the time and for his appreciation of the importance of technical training*.]

12. Ministry of Finance and Economic Planning (MoFEP)

After having done the preceding interviews, I thought it worthwhile going to find out what plans government had for promoting manufacturing in the country. My first stop was the Ministry of Finance and Economic Planning. There, I sought to see the Public Relations Officer. She was unwilling to have me, but I explained the interview would not involve anything sensitive to discuss. She then gave me her audience.

Question 12-1: What programme is government drawing up for the promotion of manufacturing practices in the country?

Answer 12-1: There has been no budget allocation specifically for manufacturing per say. Government's focus is at the moment on diversifying to agriculture to develop that sector so that everyone's attention will not be on the newly discovered oil only. Some of the agric implements are encouraged to be manufactured locally where possible.

Question 12-2: Do you perceive such attention will be given to the establishment of manufacturing in the future?

Answer 12-2: Just as I told you, now the focus is on agriculture, I can't tell what will happen in the future. If in the future we receive funds set for manufacturing, then that might be it; we will then allocate it for that.

Question 12-3: Could you please explain to me how you get the fund allocation?

Answer 12-3: What we are using for the agric diversification is money from the Millennium Challenge Package given by the US Government. That is how we get the funds, mainly through loans and grants.

[*I thanked her and left for the Ministry of Trade and Industry.*]

13. Ministry of Trade and Industry (MOTI)

At MOTI, I was received by the Director for Industry in charge of Small to Medium scale Enterprises (SME) after a long wait. The Director welcomed me and was happy to address my questions. So I began:

Question 13-1: How is Government supporting manufacturing development in the country?

Answer 13-1: Manufacturing in Ghana has a long history; we were exploring import substitution to develop the sector. We used to have GIHOC, which was an industrial development corporation for manufacturing. These were state owned under the controlled economy. At that time we had highly developed iron and steel production. Well, that system collapsed. Now, our policy is agro-processing. Thinking of manufacturing, Gratis Foundation, which is state-owned, produces some of the machines we need for the processing. Other private companies are also into agro-processing.

Question 13-2: Why did the old system under state control collapse?

Answer 13-2: It is a long story, but in short we lacked the infrastructure to keep them running. Very seriously also, the human skills are lacking as well. But one very major constrain is funding; we don't have sufficient funding to sustain the system. Funding is a very serious problem in our development; we do not get enough finance to keep up production.

Question 13-3: I was hoping that our operations will generate enough revenue that should sustain the production system, which should have led to gradually providing the infrastructure needed. In your opinion, why do you think we are able to run our production systems profitably?

Answer 13-3: You see, development is a gradual process, it is in stages; now we are an agrarian society, hopefully we will grow

to become industrialised. That is how every society develops, they start first with agriculture, build the foundation for other industries to takeoff. Our society was probably not ready for industrial takeoff at the time we were attempting it. It is a gradual process. That is why this government is directing a lot of its resources to develop the agricultural sector as the starting point for other developments to take place.

Question 13-4: What measures is government putting in place to prevent a collapse of this new system since this is also state controlled like the first one that collapsed?

Answer 13-4: The emphasis here is to direct available funds to the agric sector so that when that sector is well developed, everyone will not be rushing for the oil. At least, some people, those in the agric sector, can carry on working in their field without having to rely on the oil money. On the other hand if we get investors from the manufacturing sector, say a manufacturing firm chooses to setup its manufacturing business here, then, that will help. Government is doing all it can to attract foreign investors into the country.

[*I thanked him for the time taken.*]

14. Gratis Foundation, Wa Workshop

Gratis Foundation, formally called Intermediate Technology Transfer Unit (ITTU) is established in every regional capital in Ghana and is aimed at providing basic technological solutions, as in appropriate technology, for making simple machines and implements for the immediate locality in the region.

I visited their workshop at Wa, the Upper West Regional capital, with the intention of finding out what machines they produced for shear butter processing. There I met the Chief Security and later the Stores Keeper. The Manager had travelled, but we agreed to have the interview at a later date over the telephone, which we did.

Question 14-1: What machines does your workshop manufacture for shear butter processing?

Answer 14-1: We make crackers, for shelling the nuts and crushers.

Question 14-2: Where do you get the design from?

Answer 14-2: We design them ourselves.

Question 14-3: Could you please tell me your process of operation, how you organise your workshop in doing its business?

Answer 14-3: When a job is brought in, the technical team meets to discuss how to solve the problem. Then the job is assigned to whoever should do it.

Question 14-4: Does the technical team in your workshop produce the design blueprint?

Answer 14-4: No. That one comes from Head Office at Accra; that is where we have the personnel who do the designs. We have only one design centre.

Question 14-5: Does your workshop manufacture kneaders as well and how much will one cost your customer to buy?

Answer 14-5: Yes we make kneaders as well. One is sold for nine hundred and fifty Ghana Cedis (GHC950).

Question 14-6: How often do you get orders from shea butter producers for any of the machines to be made, or do you mass produce waiting for buyers to come?

Answer 14-6: No, we don't mass produce, we are customer driven. The shea butter producers themselves have never placed an order with us; it is too expensive for them. Cost of materials like stainless steel to make the machines is high, so they are not able to afford. Other Government Departments and Non-Governmental Organisations (NGOs) are those who normally order for the machines and donate them to a shea butter producing group hoping that they will generate enough revenue and order more to expand their business. We have never received any order from any of the groups. We suspect they are still not able to work profitably enough.

Question 14-7: What are some of the problems you have that hampers on your work?

Answer 14-7: We have serious manpower shortage. Working conditions are not attractive here so it is very difficult to retain qualified staff for design and management positions. We work with only one design centred based in Head Office, Accra. That makes our work very hard to accomplish when communicating design details and description. You know we are under the Ministry of Food and Agriculture; they are not able to make adequate budgetary allocation for us. We do not get the needed financial backing and we lack the right skills very much. People don't find the job attractive and rewarding enough to stay.

[*I thanked him and ended the telephone conservation.*]

15 Shea butter factory at Tamale

I met with the owner of the factory who granted me permission to interview her Assistant Manager and the Workers.

They were warm and generous with their knowledge in taking me through the various stages in their production process. Every step in the process was completely manual; except for the grinding of the cracked roasted nuts, which is done by an attrition machine away from the factory in a different location in the town. See figure 15-1 for operational layout of factory shop floor.

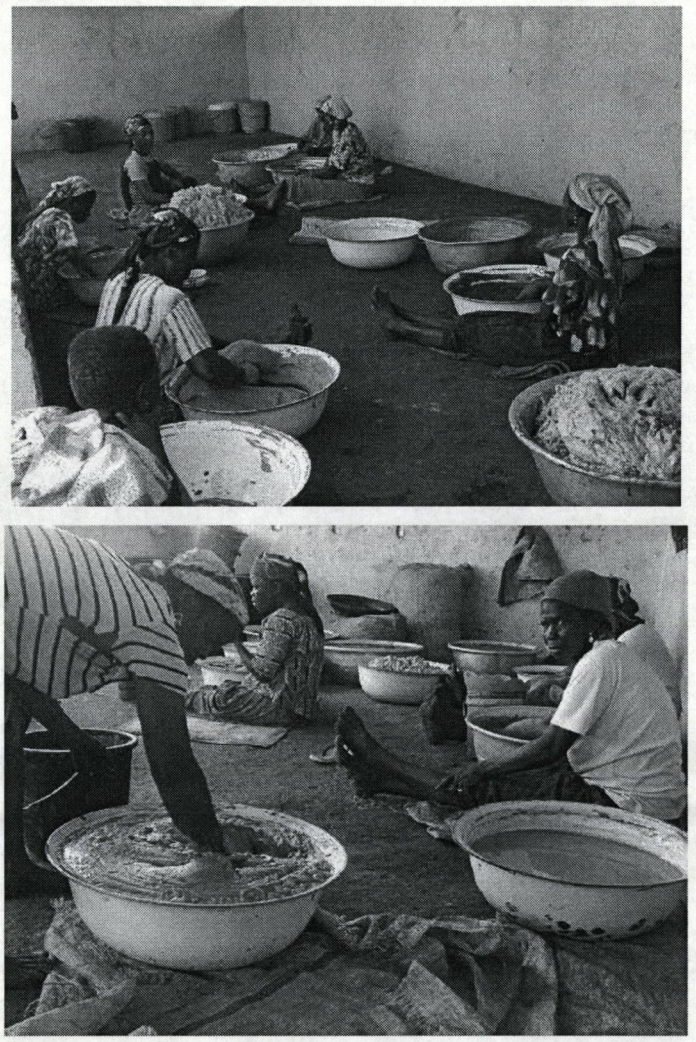


Fig. 15-1 Shea butter factory shopfloor layout and operations in process

Interacting with the workers while they were working and all women, I put the following questions to them:

Question 15-1: Would you want to have machine to do the work for you?

Answer 15-1: Yes.

Question 15-2: Why would you want machine to do the work for you? You will be bored having nothing to do and some of you could become jobless.

Answer 15-2: We won't be bored; we will be able to collect more nuts from the bush and have time to take care of our family. Machines will make the work easier for us. See us now, we are all getting old and the work is tiresome, making us age faster. If we have the machine, we can make more butter and get money to send our children to school so they can also become educated like you.

Question 15-3: How long does it take you fill this 100litre drum? (*See figure 15-2 for sample of drum*)

Answer 15-3: One person spends a week of continuous work to fill the drum.

Question 15-4: How long do you work each day?

Answer 15-4: We come here to start work 6am and close at 10pm.

Question 15-5: Not everyone in the world can make shea butter the way you do it, but when you start using machines to do the same work, your children will lose this great skills you have.

Answer 15-5: They won't lose it, we will teach them, but they will also learn to use machines instead.

[I thanked them for allowing me take part of their working time.]

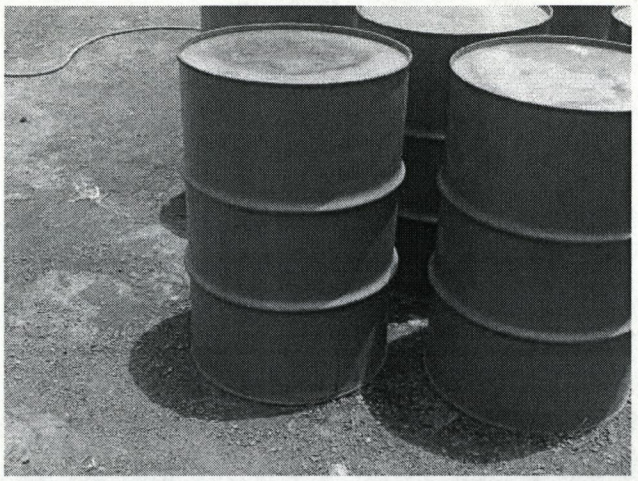


Fig. 15-2 Sample of 100 litre drum

Talking with the Assistant Manager, she expressed her own views and those of her boss; she often referred to as Madam.

Question 15-6: Your workers want to use machines to do the work for them; what arrangements are you making for that?

Answer 15-6: As for me, I keep telling them using machines will bring them problems, but they keep saying they want to use machines. Madam also wants get some machines, but the price is too much, it is too expensive. She wants to increase the butter we make.

Question 15-7: Who are you main customers?

Answer 15-7: They make the orders from mainly US and UK. When they place an order, then we ask the women to produce. We only process when we have order.

Question 15-8: Do you produce different brands of the shea butter?

Answer 15-8: Yes, we have two grades, A and B. Grade A is a better quality; we select only the good nuts to do that one.

Question 15-9: Apart from the butter, do you produce the oil as well?

Answer 15-9: No, we only make the butter.

Question 15-10: Are your US and UK customers happy with your future plans to acquire processing machines?

Answer 15 10: I think so. They helped get a roasting cylinder (*see figure 15-3 for sample and usage of the roasting cylinder*) and they are in constant talk with madam to get machines, especially one lady in UK.

[I thanked her and the factory owner for allowing me have the interview.]

Fig. 15-3 Demonstrating the use of a cracked shea nut roaster

16. Shop owner

Looking through the shelves of one of the biggest shops in Wa, I found a body moisturising cream made from USA with shea butter as the base material. I spoke with the shop owner and this is what she had to say in response to my questions:

Question 16-1: This cream is made from shea butter? Shea butter from where?

Answer 16-1:From Ghana of course. I export a lot of it to the US, Europe and Japan. I use the unrefined butter a lot myself for cooking and as body cream, but my people don't want to patronise it, they want these polished ones from the white man. See how expensive it is, but that is what they want to buy because it is from the USA. Can you imagine that? We are funny.

Question 16-2: Why do your customers prefer to use this US product instead of the locally available butter?

Answer 16-2: They complain about the natural odour from shea butter, but it can be treat it out. Don't mind them, that's not the reason; they just want to use something exotic. They think when they use a US product, then they are getting part of US life, but they are only making already rich America richer and we remain poorer. Even Americans use the butter and we are rejecting it.

Question 16-3: But don't you also think that your customers want to use this product because it is refined, but we don't produce the product varieties locally?

Answer 16-3: Even if you make it locally, they will still want the US one. You don't know our people? If we want it, why don't we make it then? My young man, I tell you the truth; it is very complex, not just what you see from the surface. Unfortunately,

all these things have their politics as well. If you get into production, you will become a threat to the American company and they will work through our politicians to stop you from taking away their market. I can't tell you all, it's very complex. Right now I speak with you Ghanaians, including my husband, are in US and other places looking for market for shea butter. They can't come home to start production, because they know these things. It's a mix up confusion.

[*I thanked her very much for the time and exposition.*]

17. Local soft drinks producer

I arranged to meet a local business man in Ho whose soft drinks business was no more in production to find out why. He was happy for the meeting to be arranged to have the interview and it went like this:

Question 17-1: Can you please tell me what kind of drinks you were producing?

Answer 17-1: They were all soft drinks, three different types; two were fruit juices and one was made from the flowers of a plant we call 'bissap'. It is the traditional drink from my village, we take it a lot. It's very refreshing for sunny days. It is a whole family production; actually, we made my mother-in-law to be in charge of the drinks.

Question 17-2: What kind of machines were you using to make the drinks?

Answer 17-2: We just make it the local way; we don't need any machines. I was planning that when the business grows, I will

then get some machines so we can sell wide, send to distant places and even increase the shelf-life.

Question 17-3: How good was the patronage?

Answer 17-3: O, it was very good. The big shops were shelving them for us and we had people selling at public places as well. It made us good income then.

Question 17-4: Why did you stop production then?

Answer 17-4: I think it was our fault; we went to the Standard Board to get certification for the drink; that was our mistake. The Officers told us to test the product on the market much longer to be sure of its success. Within that same week of our meeting them, they sent their taskforce to inspect all shops to remove all uncertified products. So they went and collected ours too. I went back to their Office to remind them of what they told me when I came there all by myself the first time, but they just insist that any item not certified had to be destroyed. I took loan from the bank to increase production at that time, but they stopped my business. I had to look for money elsewhere to settle the loan. That is what has spoiled that business for me.

Question 17-5: Why don't you get back to them for the certification and start production, or at least, sue them to recover some of your losses.

Answer 17-5: Sue them? Hahahaa.... That will be a big mistake; you'll only waste your time and money taking matters like this the court. You cannot put the corruption there in a tipper truck. Never go there. You will regret it. They'll just waste your time and take your money in addition.

Yap, I might try it again, but I need some time to come out of the earlier bad treatment I had from them. That's Ghana you know. Our people don't work by the rules; they just decide what to do as they feel like. Everybody wants to be boss in his office. The corruption is killing us, I tell you.

[*I thanked him for his generosity giving out part of his business time for the interview.*]

2nd Fieldwork interviews in Ghana

Undertaken from: 09/07/2012 – 16/10/2012

Introduction

This study looking at developing a sustainable manufacturing technology system in Ghana saw it necessary to elicit information on the ground from government officials, policy makers and selected government organisations and associations by way of interview.

All interviews were conducted by the researcher, Yao-Martin Donani, between the months of July and August, 2012 with the sole aim of identifying the policy strategy of Ghana towards its approach to developing a manufacturing technology base for the socio-economic development of the country.

Those contacted for interview included such personalities as Chief Executive Officers, Executive Directors and Managers of companies, an association, government ministries and departments including heads of some tertiary institutions. Where contacted persons were unable to take the interview, they delegated a member of staff deemed knowledgeable to in the subject of the study.

Below are the transcriptions of interviews that were conducted. Each transcription begins first by providing the basic details of the specific interviews, such as; name of interviewee, his/her position held, name of organisation and date of interview. Efforts were made to eliminate from the transcript crutch words and false starts, except where deemed necessary.

The numbering system adopted in the transcription is such that, each interview session is represented with the letter i, followed by its corresponding number, 1, 2, 3.... For example, interview 1, 2, 3 are indicated as; i1, i2, i3 and so on. Each Question and Answer (Q&A) in each interview is identified by its interview number, followed by the question number and answer number. For example, questions under interview 1, 2 and 3 would be recognised as i1-q1, i1-q2 and i1-q3. Similarly, their corresponding answers would be identified as i1-a1, i1-a2, and i1-a3.

In all, fourteen interview were conducted involving eighteen respondents, as in certain cases, more than one person was interview at the same time. Two of the interview sessions were however not conducted; rather, the interviewees provided their responses in writing and sent by e-mail. These were respondents from the Council for Technical and Vocational Education and Training (COTVET) and the Association of Ghana Industries (AGI). Also, a third respondent, from the Kwame Nkrumah University of Science and Technology (KNUST) preferred not to have the voice recorder used, as such; the interview was recorded by hand, but this time, by the interviewer.

The Interviews

Interview 1 (i1)

Name of interviewee(s): [Name withheld]

Position of interviewee: Director for Science, Technology and Innovation

Name of Institution/Organisation: Ministry of Science, Technology and Innovation (MEST), Accra, Ghana

Date of interview: 09/07/2012

(Q&A -- i1)

i1-q1 The Ministry (MEST) aims to establish a strong science and technological base in the country for sustainable development; through what mechanisms do you wish to achieve such aims for the science and technology base in Ghana as posted on your website?

i1-a1 What we are trying to do, the mechanism, 1st is to establish a solid science base, i.e. by improving research, by doing that we have to 1st renovate all scientific centres, laboratories and all that, put in modern equipment for research and science and technology generation. In addition we are trying to build science, technology and innovation parks, where researchers and industrialist or industries would work together or to forge a synergy between industry and research organisations. Then apart from that we are also, from the basic level, we are trying to equip laboratories, science resource centres with modern equipments and computers. Those are basically what we are doing to forge a very strong scientific foundation.

i1-q2 What group or types of technology are you looking at to promote in Ghana?

i1-a2 First and foremost, agricultural technology, that is, food production technologies involved in food production and

producing finished products, like turning..., instead of sending cocoa raw, they would want to put it in a finished product before it would be sold. So agricultural technology, then industrial technology, by manufacturing small, small equipment and those things we think we can use in the country. Then of course, hospitality industry and also, those are the three areas we are concentrating.

i1-q3 How are these technologies going to be obtained?

i1-a3 First, from our own universities and research institutions, then by international cooperation, then thirdly by private public partnership. Through those means we think we can obtain the necessary technologies.

i1-q4 You mean the universities should research into the technologies?

i1-a4 Ya, something like, we are encouraging them to do contract research; like for example, if we have rainfall, you see, flooding in an area, we want them to take up that sort of research, investigate into flooding. Like particular crops are being disturbed by pest, we need research, the universities and research institutions to carry out research in those directions.

i1-q5 By what apparatus on the ground would you use to translate scientific knowledge into practical technology for local and national use?

i1-a5 I think that is what I said that we would encourage contra/contract research into the various problem areas, into where we think the technology is mostly needed and also we will encourage private public partnership and also international cooperation to solve certain problems where we think the technology is necessary and we cannot easily generate it in the country we'll invite outsiders; like inter university cooperation, inter research institute cooperation for technology transfer to our people to be able to solve this sort of problems.

i1-q6 This research argues that what is needed to transform the economy is technology and technology needs to be manufactured, but your policy talked very little about manufacturing; how much emphasis do you build into manufacturing?

i1-a6 With manufacturing, that is what I said that, we are going to build science and technology innovation centres. With those centres, we think we will bring the industry and then the research institutions into play. And we will encourage things nano-technology and machine tools fabrication and those sorts of things. So those will be very helpful in industry. That is what we think. And then, you see, once, most of the industry we want to carry out, you know they are geared towards turning our raw products into finished products; like in the cocoa industry, agriculture industry and those sorts of things. So when we make these industries very strong then we will able to get the products into manufacturing.

...we are securing funding from the Chinese and money from the oil revenue will be pumped into improving technology and build science resort centres for things like nano-technology and machine tools fabrication

i1-q7 What timeframe are we looking at to achieve this translation of research collaboration with industry and translating of our primary products into secondary products?

i1-a7 We are hoping that within the next five we years, we should make a headway. And for that matter, we have gotten money from the World Bank for skill development and also for improvement in the universities building up resource centres. In addition, we've gotten some funding also..., we are getting funding from the Chinese, also much of the money from the oil revenue would be pumped into err, err, this sort of idea; to improve technology and then build science resort centres and all that. And we hope within five years we will have a breakthrough.

i1-q8 Are you looking at Ghana becoming recognised as a manufacturing country for Africa, because as at now Ghana is not known as that?

i1-a8 Well, that is what we hope, that we can, like other countries in Asia, we can also forge ahead and improve to that level where Ghana can be counted among, maybe, the middle industrial countries. And by so doing we think we will be a leading country in Africa towards manufacturing.

Interview 2 (i2)

Name of interviewee: [Name withheld]

Position of interviewee: Deputy Director for Industry Division, SME and Technology

Name of Institution/Organisation: Ministry of Trade and Industry (MOTI), Accra, Ghana

Date of interview: 09/07/2012

(Q&A -- i2)

i2-q1 From your vision statement; how do you intend to obtain the technologies needed to establish Ghana as a major manufacturing hub in West Africa?

i2-a1 One of the major sources of technology application is to get in touch with already developed technologies through our research institutions to identify technologies that are now, currently, we can utilise without paying any patent rights, that means technologies that are twenty more years in public domain. Then also through academia and research institutions partnership, we can support the small and medium enterprises through the work between the industry and academia to identify some of the bottlenecks in the processing line so that we can work with them in order to reduce waste, time, raw materials, man power and the rest. So that they improve on their cost of production and minimise it and then also their margins can improve and then they can have a lot market shares on the market for their products. There

are some areas where we must get strong partnership with the industrialised countries; something like manufacturing or mining of iron ore and processing of the ore to steel products, which can further be used in the construction, building and even in the industrial manufacturing sector to produce other products. Apart from that, in the agro-processing sector also, we have to produce, add value to obtain tertiary products from, let's say, oil palm for instance, not only getting the palm oil or refining, but also to get glycerine and other products that will be needed for value addition, high value addition, to be specific. For instance, we know of technologies available if we can process maize, high starch content in maize, we get so many derivative from maize, you know, we can even produce fuel alcohol so that we can blend it with petrol that we produce in order not to add led, it is forbidden and also not to rely on imports for these things. These are some of the areas, both in agro-processing and then in engineering, these are some of the technologies that we need.

i2-q2 How do we hope to obtain these technologies, in other words, are some of them manufactured in Ghana?

i2-a2 For instance, agro-processing, there is a bit of agro-processing going on currently, but we have to scale up the production and we have to integrate backwards to see how far the farms can produce enough raw materials so that cost of production from the farms can be reduced and make processing to develop other

products by the manufacturing sector competitive, so in that sense, research work, technology transfer to the farms, farmers, and then increasing their output and cost of production and then linking it to manufacturing sector, manufacturing industries, and then the manufacturing sector to minimise waste. And then at the same time, marketing strategies; the packaging and all those things, we'll sharpen it so that it will attract market. And also look for possible market within the country and outside. These are in the agro-processing. When it comes to iron and steel for instance, or aluminium, bauxite processing, other minerals like manganese and all those things, they are all..., when you add value to them, you get a lot of money, you increase your GDP and then these are some of the areas that we need foreign technology, foreign equipment to be able to establish. And then the skills, the human capital also need to be trained towards that.

i2-q3 It is known how GRATIS Foundation, one of your agencies, manufactures tools, equipment and machines for small and medium scale enterprises. Is GRATIS able to meet local demand as in specification and durability, what is their challenge in terms of competition in production?

i2-a3 GRATIS Foundation was established as an intermediate technology transfer unit to transfer technology to the micro and small-scale companies in the area of metal fabrication, machining, and then later on they

expanded to cover textile, tie and dye and other areas. They produce agro-processing and food processing equipment. The equipment there are almost broken down, the equipment that they use. They need state-of-the-art equipments, because, it should be an institution where small-scale companies should come and learn from them, so regularly, we should upgrade the equipment so that people can come and learn from them and also to produce within the minimum time. But currently, they are having challenges, with equipment, with working capital, but all the same other units are able to come up new types of equipment that are needed within the communities in the country. So in other words, they are solving some of the equipment needs of the communities where they are operating, but I think they can do more, they can do better than what they are doing.

i2-q4 The world is rapidly moving away from trading in primary products and moving more towards demand for value added products; what is the strategy of the ministry in fitting Ghana into this shift?

i2-a4 Before I go on that, with regards to our technologies, we have the industrial policy, and in the industrial policy, we have four components and one of the components of the industrial policy talks about technology and innovation and it highlights on equipment, manpower, ICT in industry, intellectual property and the rest. So our industrial policy covers lot areas in technology and innovation. Now to your

question; our industrial policy also talks about agro-based industries and non-agricultural raw materials for industry. Agricultural raw material as you said demand is for value added products, so as I said in the initial stages, to add value at the primary, secondary and tertiary levels, as I sited oil palm industry as an example. Not only the oil, the red oil, but to go further to produce refined oil, to produce glycerine and then to go further to produce other products. So the ministry has stated some agro products that we think we need to support within the next five years; and this include oil palm, cassava, cocoa, cotton, sorghum, sugarcane, pineapple, citrus, mangoes, tomatoes and what have you, soya and the rest, so that we can produce value-added products for both local and export market. Now when it comes to other non-agricultural raw materials, we are thinking about our natural resources; mineral deposits. And here we have the iron ore deposits; we have the manganese, the bauxite, and many more, gold and the rest. In terms of gold, the refinery and then the jewellery sector is very important. That is the primary products we can easily produce. You know some of them are using the electronic industry, but for the meantime, lets us focus on gold refinery, making it available to our local micro and small-scale jewellery industries and then helping them to expand. In other words, there are some areas like the iron ore, which opens the way for industrialisation in the engineering sector. That one too, though we have not started mining it, we are looking for both local and foreign investors to go into that area. For the meantime, what

we are doing is adding value to our local ferrous scraps. We have about five small-scale steel mills and they are producing mostly reinforcing steel rods for the construction industry. And we have some small-scale foundries also in Accra, Tema and Kumasi. They are all looking up to the ferrous scrap to add value to the local raw material. Then, as I said the bauxite; where we want to process the bauxite to alumina and other products that would have been on the shelf and we still looking for the possibility of getting investors in that area. There have been some moves since 2008. Some people have expressed interest that they wanted the government to fund it, so they would operate and transfer type of arrangement. Then apart from bauxite, also I said manganese is very important for iron and steel industries; ferrous alloys, ferrous manganese and the rest. So the focus in addition to agricultural inputs, is to process our deposits. The lime stone for instance, we are focusing processing them into clinker for the cement industry transfer. And then the salt also, we are trying to process it for the oil industry and at the same time produce soda and the rest. Some of those areas, there are challenges with the limestone deposits the salt mining; it needs an understanding between the community and the investor so that they can move the investment forward. These are some of the areas that we are trying to do.

i2-q5 Does Ghana have any system, organisation or body that is focused on manufacturing technology? In other

words, has Ghana got a method of weaning itself off reliance on foreign equipment and machines?

i2-a5 We do not have any mechanical workshop that produces parts and components and assembles them into a machines. The Ministry wanted to establish technology innovation centre for capital goods where we wanted to produce parts and components for selected plants and assemble the same into finished products for the manufacturing sector. **But the political decision has not been taken yet**, so we are still on the drawing board. We just want the private sector to take the lead. This notwithstanding, there is a project we call Rural Enterprise Programme where they are establishing what we call, Rural Technology Facility. It is something like a machine shop, where they are constructing or they building equipment to support the communities in the rural areas. They are mostly agro-processing activities. And they have started in so many areas in the country under the Rural Enterprise Programme. But to have a manufacturing facility to produce parts and components for assembly, the only one that would come to our mind is suppose to be GRATIS Foundation and then probably the Institute of Industrial Research or CSI. I can't think of anything now, but I think there are some moves by private investors to go into that area.

[[The mission of the Institute of Industrial Research is:

- To efficiently undertake applied research on industrial process and product technology development, transfer appropriate technologies as well as provide consultancy

services to small and medium scale industries and other stake-holders in Ghana and the West African sub-region.

- To move forward technological development; to become a center of technological excellence and to facilitate the acceleration of the pace of industrialization of Ghana within the shortest possible time.

  See: http://www.csir.org.gh/institutes.aspx for more institutes**]]**

i2-q6 The vision of the Ministry to develop Ghana into a manufacturing hub for West Africa; what arrangement are you making to meet the energy requirement for the expansion of industries?

i2-a6 The government has a programme to expand the energy requirements of the country. So there is a body under Energy Commission that tries to collate information from major users of energy through the ministries to forecast in five years, what would be our energy demand. You can see that, private energy providers are in the system and the government is also expanding the energy production in the country; most electricity is either from the Bui Dam or our almighty Akosombo Dam at Kpong, and then the Takoradi Thermal Plant, which is also being expanded, and then the Azogli also a Thermal plant by the Chinese. So these are some of the areas, but it's all the tariffs, tariffs is one of the areas that we should consider. For instance, if during the day the demand for energy is high, they pay the normal tariff, in the night from 10pm to 4am or 5am, the energy that is produced and not utilised, some of the major industries can have two-thirds or half tariff to support them, because in all countries, industry is supported because they know the

role of industry to add value, to employ and the rest. So these are some of the thinking, but it's all depended on the government, the people, how they cooperate and understand that, but if energy says I am here, I will not allow industry to use my energy in that manner, then there is no coordination or understanding among manufacturing, energy producers and the rest. So this is the problem.

i2-q7 Are you not considering using or developing renewable energy yet?

i2-a7 Renewable energy for industrial use; some of the large industries are thinking of establishing their own solar energy to produce electricity for them, so that is the thinking of the industries themselves.

i2-q8 For local production, like the oil palm you mentioned, shea butter, and so on, they are being criticised on the international market for inconsistency in quality; what steps are you taking as a ministry for our local productions to be standardised?

i2-a8 There are standards for oil palm and shea butter. Formerly, all non-traditional exporters had to get quality clearance from Ghana Standard Board. That was there up to 2000 or there about. But you know, quality checks takes time, so exporters were complaining that government institution in charge of standards was delaying their exports so they made the export open. That is why there are problems, complaints about standards, quality and the all the rest. And you know

that, different companies produce these items and definitely, they will not be able to produce the same standard. But that notwithstanding, Ghana Standard Board has been strengthened through UNIDO and SECO programme on Trade Capacity Burden. So government institutions dealing with standards, like the Ghana Standard Authority, which belongs to this Ministry, Plant Preparation and Evaluatory Service, which is under the Food and Ministry of Agriculture, and then Ghana Foods and Drugs Board, they all being strengthened. Their work is being accredited. So it is now within the circles of government to either instruct exporters to get education from Ghana Standard Board before they export, because, when you leave it like that, it becomes a problem. For instance, in the EU, it is mandatory that before you can export palm oil to them, you would have to get a certificate from the Foods and Drugs Board, or Standards Board. So there are some products that have to get certificate for. They make it mandatory at the ports; if you do not have that, they will not allow you to export. Now, with the shea butter, it is mostly produced by micro and small-scale companies and women cooperatives. Now that a factory has been established that will produce them in large-scale, that one too there problems; you will have refine it before you export it. So our regulation on export of these products should be strengthened to make them get quality certificate before they export.

i2-q9 Seeing Ghana relies a lot on investors to come in; what protection do you have for local industries against such external competition?

i2-a9 Now World Trade Organisation's rules and regulations, it is difficult to say you are protecting a company, but government what they is, they will support companies either through R&D work of the products you are talking about or their marketing; giving them grants and all these things, to be able to improve on their technologies and the rest. And then, also, protecting.., supporting them when they complain of dumping or any threats, an investigation can take place. So these are some of the areas that we can take up.

i2-q10 Do you think the Ghana educational system, the universities and the polytechnics, are producing good enough qualities to enhance manufacturing in Ghana, looking at future plan?

i2-a10 Our industrial policy talks about linkage between industry and academia and we are expecting management skills, entrepreneur skills, technical skill in specialised areas. We want the academic institutions to let the students in the 1st and 2nd years have better exposure with industry. So that the 3rd years or 4th years, their work can focus on some areas where they come out and form partnership and establish small and medium enterprises. Currently, in the mining sector, they are looking for small-scale companies that can produce over twenty-seven products for them; something like activated carbon, which is obtained from

the shells of coconut, or the shell of the palm kernel. If they are able to throw on that to the students, they become sensitised, they do more work on that direction, because going to university is finally to come and work, either create the job yourself or work for somebody. So if you are able to target an industry which that you know that you have a market for your products, then you start working on it, extra work apart from what teaches will try to tell you. So that when you come out, in a small-scale way you can have a job. These things, you need some knowledge about what goes on in industry. That is why sometimes, you need to invite some industrial giants to come to give a semester lecture, two, three hours on what is going on in industry in specialised areas.

i2-q11 What do you see as an obstacle to developing manufacturing in Ghana from your own opinion?

i2-a11 Developing manufacturing in Ghana, first, we should get industrial lands and then an estate for start-ups. Secondly, there should an establishment of industrial development funds to support the start-ups, because now a day, the banks shy away from start-ups from the manufacturing sector. Now the energy requirements of the estates or the industrialise zones should be met by the energy providers. Not to do it anyhow, but we have conscience that we are all promoting value-addition, value-addition brings about higher GDP. And then surely the technology institutions are also very important, they should work hand-hand, open up, invite

educational institutions to visit them, so that the educational institutions to be exposed to what is in the country and what is outside. And then, managerial skills; now a day, things are moving are fast, idea that you use today, within the next six months, it will change. So our managerial skills need to be sharpened up. And let the people also think about made-in-Ghana goods.

Interview 3 (i3)

Name of interviewees: [Name withheld] and [Name withheld]

Position of interviewees: Executive Secretary for NCTE & Executive Secretary for NAPTEX

Name of Organisations: (1) NCTE = National Council for Tertiary Education

(2) NAPTEX = National Board for Professional and Technician Examinations

Date of interview: 16/07/2012

(Q&A – i3)

i3-q1 The research wants to establish the position of manufacturing technology in the Ghanaian educational system from both the tertiary and basic levels of education. What plans is Ghana making through the institutes to establish manufacturing technology base in the country?

i3-a1 Well, my view is that, the universities, as much as possible, are not commercial centres, but they do have a responsibility to engage in research and innovation. So it is very important for us to encourage our universities to have link with industry. Currently, the situation is that, it is a very weak link. What exists is usually between individual researchers and industry, but the institutional link is weak. It's a different story with the polytechnics. It is good that my colleague is here, he would tell you about what is happening in the polytechnics and industry.

My input regarding the polytechnics is that NAPTEX is supposed to train human resource at the middle level to take charge of issues of technology and development in industries. NAPTEX coordinates examinations for polytechnics. It is a body that awards certificates at the higher national diploma levels. In this regards, the programmes that NAPTEX promotes are geared towards technology basically and at the moment we have about eleven engineering related programmes that train human resource for industry. So, in order that we should be at the cutting edge of development, we have put in place strategies even review the syllabuses and the syllabuses have taken into consideration the emerging trends in areas of technology and development. And these people who have been trained at the national higher diploma level, most of them have found employment in industries, in the oil and gas area and other science and engineering related fields. When we are reviewing the syllabuses, we invite people from

industry to tell us the competences expected from these grandaunts. And these competences actually help us to develop generic competences and others in order to bring up these graduates to be useful in industry. So I would say that NAPTEX is actually contributing a lot in the area of technology and engineering ion the field of tertiary education at the non-university level.

i3-q2 Which type of manufacturing engineering courses are offered in any of the tertiary institutions?

i3-a2 Our products are tools which are used in manufacturing industries. They operate in the areas of chemical engineering, electrical/electronic engineering, mechanical engineering, both production and plant, building technology, materials engineering and furniture engineering. I think they are about eleven engineering programmes and they are all geared towards manufacturing. We also have the feeling that these people we train need attachment or internship in the fields of this manufacturing industry simply because we do not have this manufacturing industry attached to the polytechnics. So in order to train them, we have put in place structures to that make it possible for them to be attached to these industries that I mentioned.

i3-q3 So that means, there is not a specific course on, say, manufacturing engineering, strategic manufacturing or advanced manufacturing or something directly on manufacturing offered at any level?

i3-a3 Ye, that has been a problem some years back. The products are to operate at the middle level, that is, technician engineers, to actually support those who have trained in the universities. So if you look at it very critically, they are strategic; strategic in the sense that, they can operate relative to the courses that are in the programmes. So somebody who has studied chemical engineering can also work in a different manufacturing company which has something to do with an aspect of the programme that he studied. We also have another problem here; the problem is that most of our industries have collapsed, so as a result, initially that plan that we have for industry per say are not there and that make it strategic. Strategic in the sense that, those people that help in the training of these people are invited and they actually tell us where the direct focus in or where the strategic focus should be. We have actually seen that as a problem because of this limitation that I mentioned about the collapse of the industry. That is one of the reasons why we are reviewing the syllabuses to take into consideration the emerging trends. Some of the emerging trends are in the area of service, the service industry, which more or less, has shifted a little bit from manufacturing industry, so competence, knowledge and skills acquired from there are strategically used to service these service industries in addition to what they have learnt as core subjects.

That is a specific thing; we are for policy. The details of the courses are better answered at the institutional

levels. But as a country, we concerned that universities don't seem to be showing the lead in innovation, so we are going to have a stakeholder's forum very soon to have a policy that would specifically place universities, or define a role for universities as major players in our efforts to develop technologically.

i3-q4 Does NCTE and NAPTEX make direct input into the academic courses offered at tertiary institutions?

i3-a4 NCTE is a yes and no; the yes is that, before a programme of study is approved, they here, if it is a university based programme. We are mainly interested, at a very gross level, the financial implications; whether the institution has the capacity to mount that programme. The details, we pass it onto National Accreditation, who would then go and look at the details. If it is a professional programme, National Accreditation Board involves the profession and they look actually into the details of the programme and talk about deficiencies and all that. But there is another aspect, because my colleague here is in charge of technical education; when a programme comes here, we first find out, if it is a NAPTEX approved programme and he can tell you what goes into that. If they answer yes, then we also look at the financial implications and all that and approve it for Accreditation Board. So the details, what goes into the curriculum itself, if it's for the polytechnic or a technical programme is for NAPTEX.

i3-q5 Would we consider manufacturing to be very relevant to the socio-economic development of Ghana that it

might require its own body of administration, something like how NAPTEX and NCTE oversee tertiary education in Ghana and how Cocobod oversees cocoa production and research; can we have a body to oversee how to boost manufacturing technology in the country?

i3-a5 My impression is that in Ghana, we already have a body that have that oversight responsibility for manufacturing. We have AGI, that is Association of Ghana Industries, they have oversight responsibility for manufacturing in this country, we have Ghana Standard Board, they also see to the quality of things that are manufactured in the country, and we have other related bodies, that also see to manufacturing depending on the product that is manufactured. There are a lot of bodies that I can mention. Indeed, I think it will be important for students in tertiary institutions to be trained for manufacturing. The reason is that if you look at the economic landscape of Ghana, you realise that we are now more of consumers than producers. And that has been one of the core reasons why the first president, Dr. Kwame Nkrumah, established KNUST and other institutions in order to ensure that there is manufacturing carried out. And also put in place all the necessary structures to actually promote manufacturing. There have been some problems, but I think the problems are being solved. So I would say that yes, it is important that the policy should focus on manufacturing and I think that is what tertiary institutions are there, but I would hasten to say that

there are some of these questions that can be answered by other bodies different from NAPTEX or NCTE because they are institution specific questions. But I would only emphasise here that, I think one of the aims of education is to produce productive graduates for human resource forindustry.

We already have some existing institutions like the National Standard Board looks at standards, so it may not be very helpful to have another body which would just be duplicating what other people are doing. But I think, because of the limited resources, we ought to have priorities to decide that this is the kind of industry that we want to focus on and identify the institutions that can lead these courses and channel our resources into these areas.

i3-q5 If we are to look at the Ghanaian society, which of our local productions are we going to focus our manufacturing technology build-up to address? – e.g. we have kente, shea butter, etc.

i3-a5 I am not aware of a national focus in this, but we know that we are a country's economy is largely led by agric, mining, and all that, so if I were to make a suggestion, I would look for something that would improve the agric sector, that is where I would be looking at. And that employs most of our people too.

My input here is to look at areas where we have comparative advantage and agric is one area as mentioned by my colleague. If we look at the area of

handicrafts, that is also area. I don't have the statistics, but I know that it is an area that generates lots of income for this country. And I would say that I am happy that polytechnics are also running some of the programmes in commercial arts and technology and the products are actually in this field, but we need to encourage them. We have a constraint; we know that we are contributing to the development of human resource that would actually help in manufacturing, but we have constraint of resource, resource to develop and review curriculum so that it will be in tune with the demand of industry and also make the product very very productive. Right now, most of them are running syllabuses which are obsolete and that will not help. So we have to take a holistic look at the area. We talk about manufacturing, yes, but there is also the need, looking at the policy, to strengthen that area to give it the support to be able to produce human resource in that area.

Interview 4

Name of interviewee: [Name withheld]

Position of interviewee: Deputy Director

Name of Institution/Organisation: Basic Education Division of the Ghana Education Service, Ministry of Education, Ghana

Date of interview: 18/07/2012

(Q&A -- i4)

i4-q1 What does the Basic Education system in Ghana entail?

i4-a1 In Ghana, our educational system is structured in such a way that we have the basic education sector, comprising two years of kindergarten education, six years of primary education and then three years of Junior High Schools. If you look at what goes into studies at these levels; at the kindergarten levels, emphasis is on literacy and numeracy. Kindergarten education is geared towards preparing the child for formal education, even though the education has been formalised. It used to be in private hands, but since 2007, it has been formalised to become part of the formal school system. We prepare the kids there mainly to be abreast with numeracy and literacy and then get them involved in creative arts, creative studies. After the two years, they go to Class One up to Class Six, what may be termed Stages One to Six. And then over there, they taught English, Mathematics, Science, that is Integrated Science, Social Studies, and then, they also do the Creative Arts there, and then Religious Moral Education. At the Primary School level, they also study French there, but it is not examinable, that is to prepare them for the Junior High School for three years. After the primary School, they have the three years Junior High School and that is where they are also prepared towards a Senior High School Education. At the Junior High School, the courses there comprise English, Social Studies, Mathematics, Integrated Science, Ghanaian Languages, we have several Ghanaian languages, but not all of them all taught, so they are taught what prevails in the locality, mainly what we call Twi Language, Ga, and other languages.

French is also studied there. We have basic design and technology, the basic design and technology has to do with the technical and vocational studies, where they study Home Economics and other technical subjects. Those who would opt for technical course that is where they start their preparation and then they also study ICT. In fact, ICT is also taught in the Primary Schools, so it is not only at the Junior High Schools. So for the Junior High Schools, we have English, Social Studies, Mathematics, Integrated Science, Ghanaian Languages, French, then Basic Design and Technology and then ICT. Now what happens is that, after three years of Junior High School Education, the students go through an examination call the Basic Education Certificate Examination (BECE) and then those who make the grades enter Senior High School. So the separation comes when they are going to the Senior High School. They go to the general senior high school or they can opt for technical vocational aspects and then the senior high school and I would prefer if you want ask something about the technical vocational aspects and then senior high schools, in fact our system works such that, we have divisions that handle these areas. For the Basic Education Division, we are in charge of the Kindergarten, the six years Primary and then three years Junior High School. Generally, I would say, courses there are general, except that we have ICT, Creative Arts and Basic Design and Technology happening there, but at the Senior High level, there is a split, where candidates who want to do technical vocational courses choose schools that are bias towards

that. In fact throughout the country, we have a number of technical vocational schools where those who are interested choose and go. Generally, most of our Senior High Schools do the general course, that is the General Arts, Science bias, then Business. But of course, before you enter the Senior High Schools from the JSS level, you must pass in your English, Mathematics, Social Studies and then Integrated Science, that is what we call the core subjects. And you have to pass well in two additional subjects. So the Junior High School candidates are selected to enter Senior High Schools based on good passes in six subjects; four core and two others. The two others, it can be Ghanaian Language, and any of the courses under Basic Design and Technology that is, Home Economics, Building, Technical..., all those technical subjects. So to talk about purely technical education, I was trying to say our system is divided in such a way that we have a division that is in charge of the technical and vocational aspect and we have a division that is in charge of secondary education. So the Basic Education so just one of the divisions, we have about ten divisions and I would prefer you speak with the director or his deputy in charge of Technical Vocational Education then about Senior High Schools also, there is a director in charge of the Senior High Schools, so it will be better for you talk to them, otherwise I may be giving you general answers to your questions, but they will help you better in terms of the specifics.

i4-q2 What percentage of the Junior High students go the technical section and what percentage go the general secondary school?

i4-a2 That will also be a question for the director, Technical and Vocational Education. Our technical schools are not many and so, I do not have the specific number, but when you speak to him, I think he will be able to give you the statics on that.

i4-q3 In preparing the students from the Junior High Schools to go to the Senior High, do you provide them with some form of counselling or do you study them and look out for certain talents among them to advise on which stream of education they should adopt?

i4-a3 From 2007, let me correct you, we do not have Junior Secondary Schools, we now call them Junior High Schools and Senior High Schools. Yes, it is a policy as part of our educational system that we have Guidance and Counselling Coordinators in the schools. We also have them in our District, Municipal and Metropolitan offices. It is the work of these Coordinators to ensure that these students are counselled. And even in choosing their subjects, they do a lot of work there; they invite parents, talk to them about the abilities of their pupils, their performances and then together with the pupils, counsel them on which areas they think they will do well. So there is this counselling going on in our schools.

i4-q4 What is the entry criteria for the technical section and academic section?

i4-a4 Based on the subjects that the students choose. I said, from the JSS level to enter the Senior High School, you must pass your four core subjects plus two subjects. And then if the candidate opts for a technical course, then it means that he would want to pursue a technical subject. If the candidate wants to pursue a general course or business course, then the candidate must have learnt, if it is General Arts, your English, your Mathematics, your Science, Integrated Science, Social Studies, and then maybe Economics, or Geography, or Government, or Religious and Moral Studies. You must have done well in those subject areas. If a candidate wants to opt for the technical subjects, then your English..., your four core subjects, English, Mathematics, Integrated Science, Social Studies, you would have passed in those subjects and you have done well in technical subject area. At the JSS level, they do things like calabash, they stud craftwork then they opt for those subject areas. They write the exams at the BECE levels and in those areas and when they are successful, it means they want to opt for technical or vocational area. Those who want to read business must do well in Business subjects like Accounting, Business Methods, and so on so forth. So that is what makes their selection into Arts or Technical Vocational areas.

i4-q5 What activities are outlined for these students to undertake or is their selection based purely on examination results?

i4-a5 Partly and partly on what we call continuous assessment. Whiles the student is in school, there are a lot of things that are taken into account and is assessed on all of them and records taken. So the exams results form part of the assessment and selection into this. So every student has his continuous assessment results and then his exams results. So the two put together determines his performance. So every student must have assessment in continuous assessment and then the exams.

Interview 5 (i5)

Name of interviewees: [Name withheld] and [Name withheld]

Position of interviewee: Acting Director for the Division [Name withheld]

Name of Institution/Organisation: Technical and Vocational Education and Training (TVET) Division of the ministry of Education, Ghana

Date of interview: 18/07/2012

Q&A -- i5

i5-q1 This research looks at developing a manufacturing system for Ghana; what does the Technical and Vocational Education and Training Division of the Ministry do?

i5-a1 The Technical and Vocational Education Division actually trains, at the pre-tertiary level in vocational and technical skills. And then we train and award our own certificates, that is, certificate two. Currently we have about twenty-seven course areas. Most of these courses are not design actually to address the solution that you are about, somehow, to the best of my knowledge, none of the courses lead to absolute manufacturing. We do not have any course like manufacturing technology or something like that. The best we have is Mechanical Engineering Technicians Part 1 to 3. At the Part 3 level you opt either for maintenance, that is plant or production. The production we are talking about is at least, you use the lathe machine, the milling machine, the shaping machines to imitate already manufactured part and come out with something. But actually to sit down and then create in our minds and bring it to fruition or to realise your creativity has not yet began. Of course, the country has allowed the basic level students, that is the Junior High Schools, to do Basic Design and Technology, but very surprisingly, these thing was abandoned and we do not normally do it at the second cycle levels, especially in the secondary-technical schools, where we need to enhance what we have already done at the JSS level. It would surprise you, when you go to the universities, those who train at the universities as Bachelors of Education at the University of Education, Kumasi campus, they are rather introduced again into design, what they call Graphic and Communication. So, the real people who actually matter in the delivering of

proper skills, they have been left out. It is now that we have decided as a division to reinforce, or to introduce seriously or integrate Design and Graphic Communication into the components that we teach. This we are doing in addition to entrepreneur skills training. We are still not comfortable, because we realise that we have been teaching these things for academic purposes for boys to get their marks and go, but the fact is that most of them, because our skill delivery in the technical school is not very adequate for various factors, we are able to come out to realise our ambition that, the boys could come and then they become entrepreneurs that they can establish their engineering businesses; is not happening. So we are having actually serious challenges with training to meet this important objective for your dissertation.

i5-q2 From your explanation, it is clear that technical and vocational education has not been given much attention; from your experience, what is it in the Ghanaian society that tend not to favour technical line of training?

i5-a2 I think it is the orientation we receive from our Colonial Masters. Initially, the colonial masters trained people who can actually help them execute their commercial activities. So those who were educated in the earlier days of Ghana were people who could put on flying ties, they drive in cars and they work office, so everybody copied them. So at point in time, according our educational history when the colonial masters tried to introduce skill work, according to history, our people

did not like it and it has continued all this while. So that everybody believes that when you are educated you must put on tie, you must drive in very good cars, you must work in an office, and working with the hand, they believe is for the illiterates. So most of our buildings are put by brick layers are who went through the informal apprenticeship training. Until sometime before this was incorporated into the formal technical education and still when you go round, you will realise that most of the jobs are done by those who went through apprenticeship and this canker has gone on a long way with the country. You will be surprise that the politicians would say, okay, we will build more vocational schools, so that your children who do not get access to Grammar Schools, they can go to Technical and Vocational. What sort of mentally is this one; as if those of us who find ourselves at the helm of affairs of TVET [Technical and Vocational Education and Training] in this country, we are academically bankrupt people that is why we are here. Let me tell you; when you take the GES [Ghana Education Service] entire budget, until recently, the TEVT, which rather a very expensive entity, was not taking 1% of GES annual budget. Even right now as we are talking, I think it is 1.2% or so of the GES budget. So when you go the technical schools, the workshops are just what you will see in the informal sector. So it is not attractive to anybody. And because of the reward system also, those of our colleagues who actually have this TVET background and find their in industry, they are doing fine; good salaries, good incentives. So you come to the technical schools, you

realise that these are people [*the trainers or teachers*] who could not get employment in the industry, so maybe they lack very vital skills in the delivery of this TVET, they are in the schools. These are some of the factors; at times, because they themselves do not have proper technical skills, they are unable to train to train our graduates to come out with desirable skills that can make them function well in the industrial sector. At times our training is mismatched; you train in the school system, you go industry, you realise that there are differences, because the equipment, even if we have them in the schools, some of them they are as old as my grandfather and then obsolete. You cannot train people with that one. And then funding is one major problem. If you look at the campuses of our Technical Institutes, apart from Accra Technical Training Centre, Kumasi Technical Institute, Takoradi Technical Institute, Tema and then Kukurantumi, we have about forty-five schools now, you will realise that the campuses of some of the Technical Institutions is in mockery. And of course, when I was a child, I was attracted to a particular school because of the environment. And then when you visit a technical school, as if your child has committed a crime and you dump him there. When I was a principal, once a parent came to me and said, 'this child is at the secondary school, but he is not performing, he is not performing, so I want him to come to your school and learn skills', as if skills training is for people who are not okay. That is why at times I get very embarrassed with our own country; you said people who are not brilliant, they should go and learn

hair dressing. Hair dressing, you know apply lots dangerous chemicals to the head. That person who you said is not very brilliant at school, you very brilliant person you go and sit down for that person to apply chemicals to your head. You said the guy is not doing well, so he should go be an apprentice with a fitting shop, then you buy your Mercedes, very expensive, and then you leave it at the mercy of that dull person. You see how we are thinking. I do not want to believe that, those people who are found over there are dull. These are some of the things which are preventing the real development of our nation. This was captured the Anamuah Mensah Report on the educational reforms 2006 or so. He rightly said that there is a serious deficiency in our educational system that is the neglect of technical and vocational education system. A lot of discussions have been made, but you see, we talk too much and then, little action. When we talk and money matters for the development of the education, then everybody is coming out, you see. Until recently, most our technical institutions were very bad. Those schools that have very good amenities, they were supported by International Donors. If you take KTI [Kumasi Technical Institute], it was Canadians who built the structures, and they did the initial resourcing. Accra Technical Training Centre, by the Canadians, you take Takorady Technical Institute, by the Germans, if you take Kukurantumi, the Austrians, mainly Austrians, because it is a Catholic entity, the Priest support its development. The schools that Government itself put up; how many schools can we say Government has put

this technical school consciously and is working well with very good resources? It is not there. So in a nutshell, the problems are our own attitudes, the general perception, unattractive campuses, not very qualified teachers in the area of skills delivery, poor funding and until recently we did not have any council working for us, but now we a council for TVET in the country that has been tasked to actually reform. So currently, there is a vigorous reform going on, but for me, it is too slow; because in one of the recommendations in the White Paper that Government issued on our educational reforms, Government said that there should be a radical transformation in the area of finances, in the area of remuneration, in the area of physical infrastructure for TVET. I have not seen any radical transformation; it is too slow. Because the world is leaving us; countries that have done it big, you will realise that they really developed thought this TVET. I visited Korea the other time, and I was surprised. I thought Koreans are basically fishermen, excuse me my language, but I was surprised at what I saw; claiming land from the sea, building ship, doing a lot other things. You go Austria; Austria that small country had to come to our aid with technological machines and all these things, that is what we used to resource three technical schools so far and we still waiting for them to come and help us. So these are some of the problems still affecting the development of TVET in the country.

i5-q3 Would you consider it worthwhile that there should be an overruling body to see to developing manufacturing

technology or manufacturing of technologies for local production in Ghana.

i5-a3 I think so. We have Research Centres in the country, I think if one could be as specifically designated to deal with this sort of thing, I think it should be very important. You see, we were expecting some sort collaboration or interaction between KNUST, Kwame Nkrumah University of Science and Technology, and the technical institutes, but I realised that, KNUST, they are interested in the science of engineering. They have even deviated; now KNUST, they offering Medicine, they offering other Arts subjects, and even Law and all those things. And I think, when we behave like this, it looks as if the country is losing focus, because that was not the original idea, the original objective for the establishment of that particular university. It was there to train technical men, but at a point it seem the lecturers who lectured there, all went through the Grammar System, so they did not understand why the technical school man also should come there. Even if they had created a pack long time for the practical person to go through that system, it would have been better for us now. If you go Germany, they have the have two types of engineers; the academic engineers and the practical engineers. I tell you, the other time Apostle Safo complained that the graduates of KNUST are not practical people, he was condemned by the university professors as nonsensical. I went there; I saw that the man manufactured an engine block. Even if he copied from somewhere, he has done something.

He should be acknowledged, but the professors rather said it was nonsensical. So you realise that, all the time we are interested in having goods from other countries and we are serving as marketing country for other people and we are not manufacturing. How do we breakeven with our budget? We want more salaries, but we are not doing anything productive. So these are some of the challenges. So, this your suggestion that a body could be established to deal with technological development in the country, I think is very important. We have been endowed with a lot of things; how many of the natural resources can we enhance as a country; our gold we cannot explore, our bauxite, we cannot explore, even timber, until this people bring chain saw, I think we would have been using axe. Our focus on technology is very porous. Until, maybe our politicians who have the biggest say, they begin to think and copy.

Interview 6 (i6)

Name of interviewee: [Name withheld]

Position of interviewee: Director for Research, Monitoring and Evaluation Department

Name of Organisation: Ghana Cocoa Board (COCBOD)

Date of interview: 18/07/2012

Q&A -- i6

i6-q1 What was the structure of the Board at its inception and how did it grow its long term plan to register its success today?

i6-a1 The Board, in 1947 [its inception], was established as a typical commodity board and a typical commodity board, what it does is, you know there are periods of low and high prices for commodities, so in periods of high prices, it is supposed to give a price that will stabilise and make some profit that will be used during the period of low to cushion the farmers. So out of that, it kept some as profit building the fund to cushion it. So it is how it started it.

i6-q2 What was the mechanism of disbursing your seed money for procurement?

i6-a2 The seed fund is a research development and over the period, the internal marketing was controlled by the Cocobod, but in the 1992/93 season, as part of all this structural adjustment period, the internal marketing of Cocoa was liberalised and private licence buying

companies were registered to be able to buy cocoa and hand over to Cocobod. They were not allowed to do the external export, but with the prevailing interest rate in Ghana at that time and bank regulations, it was difficult for the licence buying companies to access money from the banks; the interest rate was too high and the banks' risk large exposure to one commodity. In order to assist the licence buying companies, Cocobod then decided to go off shore borrow money from a group of syndicated banks and then on lend it in local currencies to the banks. So that is how come that mechanism started. So every year Cocobod would meet a group of banks and propose that we have a certain quantity of cocoa to be produced, we would need X dollars or X Pounds to buy, shall use our exports contracts as guarantee. That is how we started.

i6-q3 How did you avoid wide spread corruption that could have crippled the organisation?

i6-a3 There have been periods of corruption in the past. In the past, there was situation where, instead of paying the farmer for his products, the licence buyers would issue them sheets, an IOU to be paid at certain time and that created corruption. But corruption has been avoided because right now there are a lot of licence buying companies, so if I sell my produce to you and you will not pay me, next time I will not give it to you, but that does not eliminate corruption excellently, because corruption exists in different forms at different areas; there is corruption in procurement of equipment

and things as in any other situation. But we have minimised it because there is competition in the internal buying system, which gives the farmer the option of who to sell his produce to.

i6-q4 Could you describe the setup of the Board in meeting its objectives?

i6-a4 If you look at these [indicating to an organogram] the Board is responsible for the production of cocoa, coffee and shea nut. The Board regulates their market and facilitates processing. We control the marketing export of cocoa through our own Cocoa Marketing Company (CMC). So all the internal buyers do is to buy and bring it to Cocoa Marketing to export. So you see that Cocoa Marketing Company is here (showing on the chat), Cocoa Research Institute is where the research is made into cocoa disease and yield, the Quality Control, that is quality checks on the produce, these people are responsible for extension and would tackle the disease. Seed Unit is also for extension, to propagate high yielding seedlings for farmers. And we have a clinic which looks after the welfare of the farmers. So this is how the basic units of the Cocobod are structured. Then we have the Licence Buying Companies that buy from the Farmers. They act as the interface between Cocobod and Farmers, but they deal directly with the farmers; buy the cocoa and bring it to CMC for export.

i6-q5 Do you have to lobby the market for your international commodity or the market is just readily available?

i6-a5 The Cocoa market is a very funny market because the consumption is on the West and the production is in Africa, so it is important that you set up a marketing strategy to sell your beans. So when the grinders overstock, I mean when there is overproduction, they overstock and sometimes the price falls. So you need to do marketing aggressively in your markets because of the quality of your products. The market is not automatic, although so far it appears to be automatic, but there is competition from South East Asia, Indonesia and others, also producing cocoa.

i6-q6 The Ghana Cocobod was established by ordinance; this suggests that you have strong governmental support; has that really been the case over the years?

i6-a6 Yes, that has been the case. Cocobod, in the modern balance, we would say that Cocobod is a statutory government organisation; it is a parastatals government organisation with the responsibility for anything in the cocoa sector. It has strong government support and strong affiliation to government. Even the law governing it makes it the prerogative of the President to appoint the Chief Executive. The Chief Executive is appointed by the President, so he must have a strong governmental support.

i6-q7 Do you have to lobby government to get financial allocation or consignment of any sort?

i6-a7 No. The only thing that we do, is that because of the changing rules and roles in the state, because

sometimes there is exemption for the inputs that we use, the jute sac and things, so when we import jute sac and there is exemption we have to apply to government for exempt, because it is an agricultural good. Those are the kind of things; we don't have to lobby for any allocation, because we control the finances you know, so we are kind of self-financing.

i6-q8 You (Cocobod) are a very important foreign earner for Ghana economy; how has that influenced your attention received from Government?

i6-a8 That has always been always put any government's focus on Cocobod. Because anytime government needs money, it takes from Cocobod because it is a parastatals organisation, so they kind of keep a tag on our resources so at any time they know that you have some extra money you want to save for something, they can say no, we government need it for this. So government always keeps an eye on it. We have a saying that; cocoa is Ghana and Ghana is cocoa.

i6-q9 As an organisation established by Ghana laws, how do you address ethnic tension among your workers?

i6-a9 No. Well, it depends on who you talk to, because recruitment is done on merits, it is not on ethnic lines. I have not really come across ethnic tensions yet. Maybe they are underlying, but it has not come to the fore.

i6-q10 How do you (Cocobod) contribute to local manufacturing/production in the country?

i6-a10 Initially, the first major cocoa processing factories were wholly owned by Cocobod, the one in Tema and the one in Takoradi, then in the period economic decline, government decided that it was best to do a joint ventureship with the one in Takoradi, Wampco. So it has a 60/40 joint ventureship with a German company, Wampco. The one in Tema was floated on the stock exchange for individuals to buy shares. So it is supposed to be a public listed company in Tema. Then we encouraged private people to set up manufacturing concerns. We have Bari Kalebu, AGM Cocoa, Cargill from America. Those are the three giant cocoa processing firms in the country. They all have factories in Ghana. I know of smaller Ghanaian owned factories was also established. So we kind of encouraged them to establish, because the idea is that, we thought that by processing and adding value, it will enhance. We don't have to be only raw material producers, but unfortunately, what has turned is that the local factory in Tema and the joint venture n Takoradi don't seem to be running efficiently like the three big Western companies. So there is some question about our management capabilities in that aspect. I mean, that is my view of it.

i6-q11 What system do you have in place to capture and implement innovation in any of your areas of production?

i6-a11 The area of innovation which paramount is the one that deals with the production of high-breed seedlings for

farmers, because that is the root of all the productions of cocoa. So the Cocoa Research Institute has been trying to use molecular engineering to regenerate the seedlings and high-breeds needed. Then you translate it to the farmer. In our operations, ports and warehousing operations, if you study it well, we have not mechanised a lot of the loading and offloading of cocoa. If you have ever been to the harbour and see, we carry cocoa sacs on our back, purely manual. We need to move away from there. For me, my contention is that we send this cocoa to the port of Liverpool in Amsterdam; I wonder whether the white man there also carries the cocoa on his back. No. why do we load it on our backs then? Why can't we apply the same technology? That is my problem. But there is a lot resistance because, there is conception that if you mechanise, you have taken people out job. But I think that if you start loading cocoa at the age of twenty, you are not going to load it for the rest of your life. Those are the major problems of innovation that we have.

i6-q12 Have the components of remuneration and incentives for staff played a major role in the success of Cocobod?

i6-a12 I think so, I think so, because, we are better paid than other. I came from the ministry ten years back and if you know how the Civil Servant is paid in Ghana and for the kind of work we do there and come and see the work they do here (Cocobod) we are overpaid. Yes, remuneration is important; we are well paid. We pay ourselves.

i6-q13 What other motivation package do you have for your staff apart from salaries?

i6-a13 Apart from pay, every staff has an opportunity to take loan for housing, rent, furniture and things. Those are standards, for the managerial grades, we provide you with a brand new vehicle which over time, we call it owner-user, you pay for it over time and it becomes your own. Those are the main motivational aspects for the managerial staff.

i6-q14 The loan for staff; how much percentage do they pay on it?

i6-a14 It is something minimal, because if you take a loan and the interest rate in town is 20% and they charge you only 2% at Cocobod. And then they have a provident fund situation where you contribute and the employer contributes to you. Yes, Cocobod is an attractive place to work and every cocoa produced by the farmer must be bought. So the Farmer has an assured market for is produce.

Interview 7 (i7)

Name of interviewee: [Name withheld]

Position of interviewee: Public Affairs Manager

Name of Organisation: Ghana Cocoa Board (Cocobod)

Date of interview: 18/07/2012

Q&A – i7

i7-q1 The Ghana Coca Board started with forty-seven million cedes, as the seed money; what was the structure of the Board and how did it draw its long term plan to register the success it enjoys today?

i7-a1 Initially, when the Board was set up, would not have a defined structure; it would have a Chairman or Chief Executive would have started, or I think then, Managing Director was even being used. Then he would have the various departments that would need to work with the Board. Initially, the Board was purchasing cocoa, selling cocoa, researching into cocoa, and even some of these institutions that came and met, they had been in existence for a long time. Cocoa Research Institute, for instance, was established in 1938, even before the Cocobod was established. Quality Control had existed from the 1920s as Produce Inspection Company under the Ministry of Agriculture. But then, all this had to be brought together to form part of the Board along the line. So it was a simple structure from the beginning that have evolved over the period to as we find if today.

i7-q2 What was the mechanism of disbursing your seed money and procurement?

i7-a2 Seed money disbursement is just about eighteen years ago when the Board decided to go in for ???, but hitherto, other means was used to buy the cocoa; Produce buying company was the sole organisation or the arm of Cocoa Board that was purchasing. So Cocobod's funds directly was used to purchase and sell.

But when the issue of seed money came in was when the Board thought that it would get some form funds from outside, particularly to source this fund from outside, in order to be able to buy all the beans that is being produced. That was how the issue of seed money came in. And when it came in, we had to do that distribution based on merits, based on your market share and what you are doing. So as you buy, you forward what you buy to the Board, they will look at it, then advance another money to you on your target; that this is what you have been able to buy whilst we monitor everything that you do. And once you buy the cocoa, you'll have to grade it, so then it goes into quality control and comes into the system that this company has actually this week bought this much, so then the Board can sure that you are using the seed money. Otherwise..., there are sanctions; there are a number of rules and regulations that govern the use of the seed money, so if you take the seed money and reinvest it in another business, we will find out, because then you wouldn't be paying for the cocoa. There is a section; you would be made to face a penalty for doing that. So by this means, there is some kind of transparency in the disbursement and usage of the seed money by all the produce buying companies.

i7-q3 How has Cocobod been able to handle its corruption issues if there were any such instances?

i7-a3 Cocobod, like any other organisation situated anywhere in the world would face issues of corruption when you

get people who are bent on getting themselves corrupted. Cocobod has had its share [of corruption] where individual would take money to buy cocoa from farmers and would not do so. And so it would come to light that people are still keeping money and therefore, we would have to arrest them and retrieve the money. Or it could be that somebody wants to send cocoa into our warehouses has over-invoiced the consignment and therefore the system would later realise that there is over-invoicing or somebody is selling cocoa of a lower grade or adulterating the cocoa, wishing to put that into the system so he could get money for it. All these things are challenges that every system has to face and Cocobod has had its share. Legislations have been put in place, so that if you flout it, you are taken on the by courts and then you are punished. If it is a staff who acted in some way that contravenes the rules of Cocobod, that staff is punished; sacked or jailed for doing that. So by this means, although you cannot rule out entirely that sometimes you hear issues of corruption, the system is such that we become aware of some of these things and we tackle them. If I give you an instance; we send chemicals to Districts or Municipal Chief Executives to be used to spray or control pests, and then they decide to divert some and sell to farmers again, even though we were sending it free, they can get money when they resell. So they go to sell it on the market and because our staff are all over and the system is such that everybody is very alert to see whether such things are happening it comes back and we are able to hear it and we go and

arrest the people. The systems are such it cross-checks itself. For instance, if I should focus on the quality control system, because that was we are well-known throughout the world; when you buy the cocoa from the Farmer, it will be graded and sealed; it will checked. That is the quality check. When you transport from there to the Takeover Centre, before it is taken over, the same check will be done again in case you have removed the consignment and replaced it. It will be there. Even if the Takeover Centre accepts it and it is about to ship it overseas, the same check will be done again. So by that, no matter the system that you use to beat us to quality, it will be detected.

i7-q4 What has been your marketing strategy and do you always have a market available or do you have to lobby for your market?

i7-a4 I think that in marketing, you allow the market forces to work. It is a demand and supply activity. You cannot lobby people to buy if what you are selling is bad. I think those in marketing are far gone. So our strategy is not that of lobbying. Our strategy is to produce the best in the world and people would come and they would chase it up. And so we forward sell that [best in the world], because people are chasing it, they even want it before the trees produce them. But then we would have to use other tactics; we are forward selling, but can we hold on some to take advantage of better prices when it comes on spot? So we reserve some for spot to take advantage of good prices.

i7-q5 Cocobod was established by ordinance; this suggests that you have strong governmental support; has that really been the case over the years?

i7-a5 I hope that you have heard that cocoa is Ghana and Ghana is cocoa, and that answers the question that if you talk about Ghana's development, you cannot leave cocoa and therefore, it means there is a strong bond between government and cocoa industry and because it employs a very large number of people, if Government ignores cocoa industry, or Cocobod for that matter, it will be difficult. And a lot of the things that have taken place in this country have been done by cocoa money. And that is why it is said that cocoa is the backbone of Ghana's economy and it will remain so for a long time. So, yes, there is close collaboration between Government [and the Cocobod]. Even though on commercial lines, on business lines, Cocobod is independent; it takes own decision as to what to do, to make it commercially viable government support is also very important to enable Cocobod to implement its policies, so that there will be peace among the larger populace of the country.

i7-q6 What kind of support does Government give the Board?

i7-a6 Policy support. The government will not give us financial support, but it can give us approval, say for instance we want to sign a trade assistance facility, we cannot just go into the International Community and sign that facility without Government saying that, okay, it is approved, go and take that money, because,

should we default, Government will brought into the question. So, we get support from that, and a number of things. I would say that all governments in Ghana had cherished cocoa as the hen that lays the golden egg and therefore, there is a very good relationship there.

i7-q8 As an organisation established by the Ghana law, how do you address ethnic tension among your workers since Cocobod employs people of all ethnic backgrounds?

i7-a8 I don't know if you have heard of any organisation in Ghana that has ethnic tensions among its staff. Ghana do not have ethnic tensions; by and large, the country is very multicultural. You know how people from different parts of the country all group together in a boarding school. So, for us, yes, there are different ethnic groups in the Cocobod, and the workers also are governed by rules and regulations. There are codes that they have abide by; those who are unionised have collective bargaining agreement; what the staff should do, what not to do, what constitutes a breach of the organisation's rules and then there are other general rules for personnel of all departments. With that system, it is easy to address issues that will militate against the company's management.

i7-q9 What system do you have in place to capture and implement innovations?

i7-a9 There is a good reporting system within the Cocobod system, which means that those down there can suggest something to their immediate boss and it will carry on until it gets to the Chief Executive. So there are reports, for instance, there are weekly reports, there are monthly reports for every subsidiary that will go the Regional Manager or Regional Administration, they would also forward the same to their various offices. It will be summarised and sent to the Head Office, to their various sections, and that would also be summarised. At the end of the day, the Chief Executive will get to know what is very important. So, a number of organisations or Units are able to bring up innovation. For instance, we use to cut down mistletoe with cutlass, but now technology has improved and now we are able to use a machine, a chain saw machine that has a long stretch and it able to cut these mistletoes and a number of things. The Cocoa Research Institute has various departments right from soils to plant breeding that will investigate their various sections and bring in changes. That is how come we have highbred variety that will yield in about two years instead of allowing the trees to get to five to seven years grow. So there are a number of innovations that come; when you get to the Takeover Centre, hitherto, people will be carrying the cocoa by their heads all through. Now we are able to use conveyer systems to do that. And even if you get to our new facility in Kejegrui and Takoradi, we have container depots; we have systems that able to allow us to load the containers with naked beans without necessary getting individuals to sac. We are putting in

stackers, and other systems to make it stand to any international level. So we are adopting all the technologies that is necessary, now, we do not count the cocoa bags; we use the weighing bridges to check the weight as the vehicles arrive and that speeds up our activities. Innovations come. Even if you suggest something, we will look at it.

Interview 8 (i8)

Name of interviewee: [Name withheld]

Position of interviewee: Procurement Manager

Name of Organisation: GRATIS Foundation, Headquarters, Tema. [GRATIS – Ghana Regional Appropriate Technology Industrial Service]

Date of interview: 24/07/2012

Q&A -- i8

i8-q1 What does GRTATIS do and how did it come about its mission and vision statements?

i8-a1 GRATIS is in principle; a training, manufacturing and in the very recent past, a learning and teaching institution. With the learning and teaching is distinct from our training.

i8-q2 Could you explain your mission statement and vision statement a little more?

i8-a2 Our mission statement has been derived out of a consultative consultancy assignment that was given to

the Ghana Institute of Management and Public Administration [GIMPA]. The government of Ghana with assistance from the World Bank wanted GRATIS to be restructured. So after GIMPA's work, which they did together with GRATIS staff, stakeholders, like our Sector Ministry, other relevant Ministries, this is the mission that the GRATIS Board and the Government of Ghana have accepted as the working document.

i8-q3 Could you give a brief history of how GRATIS started, what inspired its formation?

i8-a3 It's a long story; it goes as far back a 1987. In 1987, work that had already been done at the Technology Consultancy Centre [TCC] of the Kwame Nkrumah University of Science and Technology [KNUST] the Government of Ghana gave GRATIS the mandate to duplicate the work that had been done by the Technology Consultancy Centre that I mentioned. The Technology Consultancy Centre (TCC) established the first Intermediate Technology Transfer Unit [ITTU] in Ghana in 1982. So from '82 to '87, the TCC or the Suami ITTU, that is Suami Intermediate Technology Transfer Unit was operating and the success of its operations convinced the Government that GRATIS should go nationwide, I mean, not only limit itself to the Kumasi area, but should be establish ITTUs in the remaining nine regions of Ghana; nine regional capitals of Ghana. That is how the whole thing started.

i8-q4 From your vision statement, GRATIS wants to become a centre of excellence for research and innovation for

appropriate technology products and services in Africa; how do you hope to achieve that?

i8-a4 We will not stop learning; we will build on the experiences we've had; we will recruit the right calibre of people; we will motivate them; we will continue doing research; we will continue prototyping we will continue manufacturing and we will continue teaching and learning. This is how we will come by our vision.

i8-q5 Looking at your goal, do you have any organisation with which you are benchmarking GRATIS's performance or operations?

i8-a5 Ours is collaboration; instead of looking at somebody and say, hey, I want to be like this entity, we would rather collaborate with similar organisations to come by our vision and goals and all those things. We won't look at anybody.

i8-q6 So do you think GRATIS is strategically positioned in Ghana to meet the local technological needs of the country for local productions?

i8-a6 In fact, the Government of Ghana doesn't see the relevance of GRATIS in its industrial development.

i8-q7 Is GRATIS autonomous, or is it run by subvention from Government?

i8-a7 We are a Government of Ghana Agency. We operate under the Ministry of Trade and Industry. We operated under several Ministries, and when the ministry change, then GRATIS moves. When we started, we were under

[the Ministry of] Industry, Science and Technology, then we went to [the Ministry of] Science and Technology then we went to [the Ministry of] Environment and Science, at one point, we even went to [the Ministry of] Communication and Technology. The change and the ministry also change, but currently, we are in the Trade and Industry.

i8-q8 When you make profits, you do not have control over it?

i8-a8 Government does not take it from us, because we use our margins to train suggests that govt gets no direct financial benefits from GRATIS, we use our margins to do research, we use margins to do prototype, so we don't pay any dividend to the Government of Ghana. On the contrary, the government pays us our salaries, gives us subvention for administrative work, subvention for the services and even assets, like buildings, vehicles and so forth. So we are fully under the Ministry.

i8-q9 Do you advise Government on matters of manufacturing and technology?

i8-a9 Definitely. That is what we do. We are the Government technical wing, so advise and the Government advised and we go ahead.

i8-q10 Does Government link you up with similar international manufacturing organisations?

i8-a10 Definitely. Africa Regional Centre for Engineering Design (ARCEDem) in Nigeria, African Regional Centre for ..., the one Senegal; ARCT and we've also, through

our manufacturing and training, gone to a lot sister-African countries. At the moment, we have one technical person in Cameroun doing training on an equipment we manufactured and sold to them.

i8-q11 It means you sell your products internationally, across the Ghana boarders?

i8-a11 Definitely. Sierra Leone, Liberia, Cameroun, Burkina, Benin [Republic], our products are there.

i8-q12 Do Government Departments place order for your products, such as machineries, and do they pay promptly? And in case they do not order for your products, do they import similar products you could have manufactured?

i8-a12 The Government often source products from GRATIS because they know our capability, instead of going national competitive tendering or international competitive tendering, they go straight to GRASTIS. In some cases, GRATIS is encouraged to bid, like this waste containers and so forth and in those ones, we can either win or lose, but we have attempted quite a few that..., maybe because we want quality our prices are a bit on the high side, so we lose out on some of the Government contacts. But when they know we can be competitive because of past experiences and so forth, they come directly to GRATIS.

i8-q13 Could you explain briefly why sometimes your products are on the higher side in terms of price when compared to your competitors?

i8-a13 Quality! and the fact that some of our competitors would from outside [outside the country], they would use wayside [unqualified] personnel to do the work. The quality is what makes our prices a bit higher than what you will find with our competitors, or from China or India.

i8-q14 What products do you manufacture that you have to sell at a higher price compared with other competitors?

i8-a14 Our main line is food processing; that is, agri/agro; because now we are manufacturing mowers and planters and also sanitation.

i8-q15 Do you see expanding markets for your products within the local market for local industry?

i8-a15 As for industry in Ghana, GRATIS is like..., more or less, I won't say a one-stop-shop for servicing, for spare parts, for rehabilitation of equipment in industry, but we do a lot work for industries in Ghana.

i8-q16 That means local producers like palm oil producers, shea butter producers, *kente* producers come to you?

i8-a16 All those people, the equipment comes from us. There are others who also do the same thing. But the big boys in Ghana, I mean, the big industries, like VALCO, the Mines, the Fishing industry, and so forth, the spares, the maintenance work, is by us, because they our head office is situated in the industrial area in Ghana, we get a lot of work from industry.

i8-q17 So you work both for the local industry and for the multinational corporations?

i8-a17 Defiantly, definitely, both micro, small, medium and the big boys.

i8-q18 With regards to the local industry; how are they able to acquire the equipment from you in terms of payment?

i8-a18 The big boys will pay upfront or we go into a contract and they honour and we also offer concessions, we give them discounts, we give them warrantees and so forth. So they like doing business with us.

i8-q19 So what about the local industries who are not able to pay upfront?

i8-a19 The medium and small; sometimes they source from Government to buy from GRATIS or they take loans from the banks and buy from GRATIS. But the NGOs and the Government also help this micro, small and medium [enterprises] to get equipment from GRATIS.

i8-q20 That signifies GRATIS is operating very satisfactorily in meeting industrial demands in Ghana?

i8-a20 We are not doing too badly. I do not think we have competitors in the sort of work we do.

i8-q21 How do you source for funding for GRATIS's operations? Does GRATIS run as a charity or as a business organisation?

i8-a21 Until 2007 and before that when GRATIS was established in '87, the two main donor-agencies were

the European Union and the Canadian Development Agency. These two donors saw GRATIS through three phases of its development; equipmentwise, vehiclewise, funds for trainingwise until 2007 when they exited, because they felt they've done what they could and we could now stand on our own. There were other smaller donor-agencies; Europeans, Japanese that also helped, but from 2007, GRATIS has had to rely on its own resources and those that the Government of Ghana provides. And the Government of Ghana would provide so that you are on your feet, by giving you the chance to bid and compete with others to win contracts.

i8-q22 How does GRATIS manufacture its products; do you have the blueprint, or do you replicate existing work or reverse engineer?

i8-a22 We do all the three schemes you have mentioned, but our unique advantage is that, we have and Industrial and Engineering Design Centre (IEDC), so some of the things that we produce, they come from doing research, prototyping and testing in the field before they are sent out. We adapt; we do reverse engineering, we copy it, and we also research, design, prototype, test, and put the equipment in the field.

i8-q23 How much of your budget goes into research and development?

i8-a23 We are not getting enough from the Government to be able to say this specific is going into what, because what we earn stays with us, when someone comes here

that I want this done, then we allocate money. We don't put a percentage.

i8-q24 Do you have an approach whereby you are able to identify a need for equipment in the society?

i8-a24 Don't forget, we are all over the country. Apart from the nine Regional capitals, working together with what used to be the Rural Enterprises Project, but now the Rural Enterprises Programme; GRATIS, working with the District Assemblies and the Rural Enterprises Programme, is running twenty-one centre and facilities in Ghana. So it is not just GRATIS Head Office and the nine regional capitals. GRATIS Head Office and twenty-one districts and municipal assemblies do have the basic metal machine, the basic metal fabrication equipment with some staff, all GRATIS and other staff partly GRATIS. And these twenty-Centres are also working. These staff, our Technicians, our Managers, they go out and they see what needs doing, or what is needed. And then they consult Head Office and then the prototyping and design is done, and then the need is satisfied. So, because we are all over, we can actually see what is needed [in the society].

Before this our recent restructuring, the team initially consisted of engineers, socio-economists, marketing people, sociologists and whatever. Now we have narrowed it down; our main focus is the manufacturing, the teaching and the learning. As for the research, that is backbone. You can always contract these expertise

when the need arises. In fact we are even thinking of having a university.

i8-q25 What is your opinion about GRATIS evolving into an autonomous establishment solely with the responsibility of developing technology for Ghana the same way Cocobod is for cocoa?

i8-a25 In fact, that is our ultimate goal; we should be on our own so that we are better able to recruit and retain the staff. At the moment we are being paid the Government so the salary levels very, very low, they are not competitive, they don't entice. The Government and GRATIS itself have that goal in mind. We should be autonomous, but we shall never wash our hands fully off the government.

i8-q26 In your manufacturing processes, how conscious are your Designers, Engineers and Technicians on issues of sustainability?

i8-a26 It is something that is in-built [in our processes]. We have a manual; I can't give it to you now, which outlines what needs to be done, being mindful of the environment, right from raw materials to design to final manufacture. We send our staff on training for the environment.

i8-q27 What is your staff strength in the sense of areas of expertise?

i8-a27 After the restructuring, we saw ninety-four, out of a total of two hundred and thirty leave GRATIS

voluntarily. We are now having to recruit, aiming to 80 to 85% technical staff and then 15% support and administrative staff. This technical staff, we are looking at first and second degree Engineers, HND holders, Technicians, Shop Floor Technicians.

i8-q28 Where do you hope GRATIS will be in the next ten to twenty years?

i8-a28 I think it will be centre of excellence we are talking about.

i8-q29 Do you hope to produce more of this Regional Training Technology Centre?

i8-a29 In fact, there should be thirty more Rural Technology Facilities in Ghana according the African Development Bark's document so that, every metropolis, every municipality, every District would be served. But we are thinking of varying our activities instead of the current metal machines, welding and fabrication into other areas like, electronics, develop new materials, use fibreglass and so on.

i8-q30 What would you say are the main challenges confronting the development of technology in Ghana as you may have experienced from GRATIS.

i8-a30 Its always finance.

Interview 9 (i9)

Name of interviewee: [Name withheld]

Position of interviewee: Rector of Accra Polytechnic

Name of Institution/Organisation: Accra Polytechnic

Date of interview: 29/08/2012

Q&A – i9

i9-q1 This is an institution of higher learning; could you please give a brief account of the general structure of programmes and courses you offer in engineering? Specific details are not required.

i9-a1 Accra Polytechnic is a multidisciplinary in terms of its programmes and it runs the Business, the Applied Sciences and the Engineering programmes. We have majority of the population of the students to b in the Business [programme] unfortunately, because that is not the main purpose of the nation. The nation Ghana tries to uplift, in terms of numbers, the engineering and science and had instituted a 60/40 ratio, but unfortunately, the infrastructural development are not adequately enough to cater for the numbers of applicants and a lot of the students go in for the Business, just because the industries relatively are few in Ghana and competition for places is also keen. But we have relatively large number of this engineering students. For the School of Engineering, or I would rather say, Accra Polytechnic is made up of three schools. We have the School of Engineering, which is made up of departments like Building, Civil Engineering, Mechanical Engineering, Electrical/Electronic Engineering and each of these have their specified areas. For example, in Mechanical Engineering you

have Automobile Engineering, you have Construction and other programmes. Now when you come to the School of Applied Sciences, over there you have programmes like Science Laboratory Technology, you have Fashion Design and Technology, Hotel Catering and Leisure Management, you have Statistics. And when you come to the School of Business, you have Liberal Studies, you have Accountancy, you have Marketing, you have Purchasing. Currently, we have included the IT, that is Computer Science, which of the School of Applied Science. So, basically, we have laboratories and workshops which do help in the teaching and learning for the students. We also have some of these programmes undertaking this Competency Based Training or Learning [(CBT/L)]. And we have the Fashion Design Technology; that one has undergone this CBT. We also have Mechanical Engineering, which has also undergone CBT. Others are also on the pipeline to undergo the CBT. Why, because, this is more on hands-on approach, whereby the students are exposed to doing things, creating and innovating and getting some projects carried out. Some do it on their own, some do it together with their lecturers or supervisors and they carry out some projects. So basically, that is about the programmes and the schools that we have in Accra Polytechnic.

i9-q2 About syllabi review; how frequently do you review your syllabi?

i9-a2 As for the syllabi review; this has a national approach. Because the polytechnics do each of these programmes in the ten polytechnics in Ghana. So there is always a plan for two year syllabi review, but sometimes, it goes beyond the two years due to some constraints. And we normally have a team from each of the polytechnics reviewing each of the programme syllabi and sometimes, there is the need to have a second review with our collaborators like NAPTEX [(National Board for Professional and Technician Examinations)], NAB [(National Accreditation Board)] and headed by NCTE [(National Council for Tertiary Education)]. So this is how our syllabus are always reviewed.

i9-q3 Looking at technology needed by local industries in Ghana; have the polytechnic institution been structured to provide the technologies needed by local industry?

i9-a3 Yea, that is the aim, but the manner in which the polytechnics were setup, most of them were developed from non-tertiary institutions and the planning was not all that very concrete. But the idea is to develop it to meet the local demand as in terms of industry, as well as that of international need. But because of the low levels of various industries in Ghana, sometimes there is inadequate levels of what is aimed to be done and what is actually done. But we have what we call Institutional or Academic Industrial Collaboration, which tries to get problems from industry and the institutions, sharing challenges and trying to find solutions to these challenges.

i9-q4 Would you consider it worthwhile for Ghana to have a body set up specifically to see to the manufacturing of technology for local industries in similar way as Cocobod is set up for cocoa production, research and quality?

i9-a4 Yes, I do agree to this; yes, there is the need and you, some years back, there were some research centres for the second cycle institutions and I was thinking that if these were to be replicated at the tertiary level, because of inadequate financial constraints, these would help to boost up the research and production activities in the country through the polytechnics. So it would be a laudable idea and then also increase the interlinkages between the institutions and the industry.

i9-q5 What other tasks should such a body address?

i9-a5 Such a body should look at basic community challenges and intensify on collaboration and advocacy, getting the government to understand their drive to achieving their goals from combining research and production. That will help.

i9-q6 Is there any question you would like to ask?

i9-a6 The world is now a global village; there is the need to have some international linkages, there is the need to have international collaboration and sharing of resources. The internet could be used as a tool and it will ease and make things go faster. And if it is equipmentwise, then, that is what I said, sharing what

we have, in terms of equity; it will help to get this programme, research and production, go far.

Interview 10 (i10) – Interview not voice recorded as requested by interviewee

Name of interviewee: [Name withheld]

Position of interviewee: Head of Mechanical Engineering Department

Name of Institution: Kwame Nkrumah University of Science and Technology (KNUST)

Date of interview: 30/08/2012

Q&A -- i10

i10-q1 This is an institution of higher learning; could you please give a brief account of the general structure of programmes and courses you offer in engineering? Specific details are not required.

i10-a1 We offer fourteen programmes in engineering here at KNUST. They are BSc Agric Engineering, Civil, Geology, Geomatic, Aerospace, Computer, Petroleum, Telecommunications, Electrical/Electronic, Chemical, Biomedical, Mechanical Materials and Metallurgical Engineering.

i10-q2 What was the mandate for the setting up of this institution?

i10-a2 Some of the questions are beyond my authority to answer. I may have the answer, but in my capacity as

Head of Department, some of the questions would be better addressed at higher authorities, however, I would give you some documents of the University which have information suited for the general domain. I think there you can find the answer to your question. [Extracts from the 46th congregation and a brief history of the university were given to me].

i10-q3 Do you offer programmes in manufacturing, such as Manufacturing Engineering or anything like that?

i10-a3 No, we do not offer Manufacturing Engineering, but we offer programmes in Mechanical Engineering with specialisation, options in Industrial Engineering and Design Engineering. We however have proposal in place for the introduction of a course in manufacturing. At the Master level, though, we have MSc Design and Manufacturing Engineering.

i10-q4 What factors determine the programmes you offer? Are they job prospects, students' aptitude and qualification or societal dictates?

i10-a4 The main stimulus that eventually determines and mostly influences the courses we run at the university is societal needs. Our future plan to introduce a course in Industrial Engineering is as a result of perceived need. At the moment, we give our students a bit of Industrial Engineering training in anticipation of an industrial boom in Ghana in the near future seeing the coming in of the oil and gas industry in the country.

i10-q5 How frequently do you review your syllabi and what prompts the review?

i10-a5 We review our syllabi every four years as a statutory requirement of university.

i10-q6 Do you train your students to suit international standards or for the local economy or for both?

i10-a6 Both. Our curriculum is not drawn in isolation. We consult other institutions in other parts of the world.

i10-q7 Do some of your engineering students' final year projects focus on improving traditional production methods, like pottery, *kente* weaving, shea butter production methods, etc?

i10-a7 Yes. Our students' projects centre a lot on agro-processing. We also do a lot student research into waste management equipment used all over the country.

i10-q8 By what means are students' project results relayed to industry?

i10-a8 No; students projects are sent to industry. I intend to pursue that as the new Head of Department. I have made that one of my targets; to relate students projects to local industry.

i10-q9 Is your staff strength adequate to transfer the requisite knowledge for a manufacturing programme when you run one?

i10-a9 Yes, we are well endowed, though other departments are distressed, Mechanical Engineering Department is well endowed with staff to handle courses in that programme.

i10-q10 Looking at the technologies needed by local industries in Ghana; how should such technologies be obtained, maintained and developed?

i10-a10 A multi-path approach need to be used; some of them I consider is to adopt existing technology and develop our own technologies from them. We can also copy and share the technology to other industries in the local economy.

i10-q11 Which areas of technology would you suggest should attract a strong attention for development?

i10-a11 Agro-processing, waste disposal management and vehicle parts and maintenance products. Also building and construction technologies and food processing equipment.

i10-q12 Would you consider it worthwhile for Ghana to have a body set up specifically to see to the manufacturing of technology for the local industry, the same way Cocobod was set up to oversee cocoa production, research and quality?

i10-a12 Yes. I once proposed such an approach, which I called Science, Engineering and Technology Council. I suggested such a council should have the placement, such that it reports directly to the President. Its task

would be to design and manufacture, to come out with products that are strategic for national development. For example, over 90% of our cocoa is exported for decades. Government could induce companies in design and manufacturing to transform our raw material into finished goods. Nothing prevents Government to induce and reward people who would design and produce machines for cocoa. Design companies could be created; it would also create jobs, and so on. Manufacturing jobs, not to talk of auxiliary jobs like accountants, lawyers, medicine and the rest. We would also have the potential to export such machines, but we need the leadership from Government in this area; it is at the moment lacking. Currently in Ghana, we are not mobilising the engineers and scientists for national development. Leadership is the greatest problem in this case. The type of government we have, the parliamentary system is not good for Ghana. The president needs more power, but the president must be a benevolent one, not a dictator. Current parliament system of government does not allow the president to do what he or she sees as needed to be done. [Benevolent dictatorship]

i10-q13 Is there any question you would like to ask?

i10-a13 We should have a timeframe; a well-thought-out plan, say in thirty years, twenty years we have to develop to capability of doing this or that, e.g. manufacturing our own agricultural machines.

Interview 11 (i11)

Name of interviewee: [Name withheld]

Position of interviewee: Head, Quality Assurance Unit (Deputising for Rector)

Name of Institution: Kumasi Polytechnic

Date of interview: 31/08/2012

Q&A -- i11

i11-q1 This is an institution of technology; could you please give a brief account of the general of programmes and courses you offer in engineering. Specific details are not required.

i11-a1 Kumasi Polytechnic is basically an institution of technology as you said. It started really with this technical technology programme until recently when went into business areas. By and large, we have a very large faculty of engineering which offers programmes in various departments. We have about six or so departments that offer engineering programmes and one of such departments is the Mechanical Engineering Department, which also runs core programmes. We have Plant Engineering, Production Engineering, Automobile Engineering and Foundry and Technology which are the programmes that are run at the Mechanical Engineering Department of the of the Faculty of Engineering.

i11-q2 What was the mandate for setting up the Institution?

i11-a2 This is a general mandate for all polytechnics, that it trains technological experts for the industries. It used to be the middle level manpower situation, but now its train technological base experts into the Ghanaian industry.

i11-q3 Do you offer programmes in manufacturing, such as; Manufacturing Engineering or anything of that sort?

i11-a3 No we don't. We have some aspects of manufacturing engineering in production, we call it Production Engineering. Then some greater aspect deals with manufacturing engineering.

i11-q4 What factors determine the programmes you offer? Are they job prospects, students' aptitude and qualification, social dictates or what?

i11-a4 Normally, it is the demand of industry. We have constant link with industry and they comment on observations that they make that most of the time we take on what we should do so that we will be able to satisfy them. By that, we will also be looking at the job market. If we are able to satisfy industries, then we are also creating jobs for our graduates.

i11-q5 How frequently do you review your syllabi and what prompts the review?

i11-a5 Normally five years, between three and five years. If we go by our normal accreditation processes, then five years, we need to review it. If we depend on our link with industry, then three years, because if we see the

need for us to quickly adjust to accommodate the industrial needs of the country, then normally, three years.

i11-q6 Do you train your students aiming to suit international standards or for the local economy and how do you determine both cases?

i11-a6 We look at the need of our local industry first and by that we are able to train them to satisfy international needs, then fine. Otherwise, our direction is to our local industry.

i11-q7 Do some of your engineering students' final year project focus on improving traditional methods of production, for example, pottery, *kente* weaving, shea butter production?

i11-a7 We cover a wide range of project titles, moving from traditional production to more sophisticated methods.

i11-q8 By what means are students' projects relayed to industry?

i11-a8 What happens is that, we have attachment, students industrial attachment, we have that, then we have students' educational visits to industry. This is done as often as we find the need. The attachment is once a year for twelve weeks.

i11-q9 Is your staff strength adequate to transfer the requisite knowledge for a manufacturing programme if you decide to mount one?

i11-a9 Yes, we have a reasonable number of staff and fortunately for us, we are positioned in a situation where we are able to get assistance from other tertiary institutions. KNUST is there, and CSI is there, Centre for Scientific Institution. We have about three of them in Kumasi and we also fall on them for some kind of collaboration.

i11-q10 From your experience in the educational setup, as a Ghanaian and from the field of technology, how should technology required for local industry be obtained? Should we look at creating them, developing them ourselves, or should we look at importing and adapting to them?

i11-a10 There are two ways that we can talk about this and that we normally do; we look at our situation and we create. We look at the advanced zone and then we adapt them to our situation and then we combine the [number] two; going straight to using the advanced technological tool to the local, or starting right away from the scratch trying to solve local problems. But we are normally in the two; we start from the scratch and then we adapt.

i11-q11 Which areas of the technology would you suggest should attract strong focus for attention for development?

i11-a11 We have to go in phases. We are primarily agro-based country. Everything depends on agric and we may have start with this agro-base and that will help us to launch into other areas like electronics.

i11-q12 Would you consider it worthwhile for Ghana to have a body set up specifically to see to the manufacturing of technology for the local industry in Ghana the same way we have Cocobod for cocoa research and production?

i11-a12 It looks like we have the body already, except that we need market to publicise the activities of this body. I am talking about Council for Scientific and Industrial Research. If we collaborate with them, we may be able to bring out this manufacturing. We have the Industrial Research Institute that is one of the organ of it, we have the Building Research Institute. These are geared towards this manufacturing. They also look at the local need and then try to create things to suit that. So I would like to say that there is a body there already, except that, we haven't publicised their work and marketing them.

i11-q13 What is responsible for they not being highly recognised?

i11-a13 It is both societal and governmental factors. We are in a society which would only want to go straight to already developed systems instead of looking at our own situations and need and then creating systems to suit us, we are not interested in going through research and coming up with products that would be beneficial to us, but we want to import and adapt to the system to our need.

are set up and they are the driving force for the programme that we offer. See that at a point, even though we are suppose to be an institution of technology, sometime, because of the need, we train other people who into Fashion, others into Hotel and Catering Management. We train people in Accountancy and Business, depending on the need of the country at any particular time. So it is societal need, national need that mostly dictates our programmes.

i12-q5 How frequently do you review your syllabus?

i12-a5 We are suppose to review our syllabuses every three years, but because of the huge capital involved in doing it, sometimes it can delay about a year or two, but mostly after five years, four years, we to review our syllabuses. The review of the syllabus is prompted by changes in technology worldwide. As the world is changing, as technology is changing, we have to get our students updated.

i12-q6 Do you train your students to suit international standards or for the local economy or both?

i12-a6 When you go round this globe, you will find our polytechnic students everywhere. I do get requests from all over the world asking us to comment on some students who are applying to jobs at various places. And sometimes, they ask of the syllabus we use to train them to adjudge whether they are capable. Yes, we train our students to meet all sorts of standards

i11-q12 Would you consider it worthwhile for Ghana to have a body set up specifically to see to the manufacturing of technology for the local industry in Ghana the same way we have Cocobod for cocoa research and production?

i11-a12 It looks like we have the body already, except that we need market to publicise the activities of this body. I am talking about Council for Scientific and Industrial Research. If we collaborate with them, we may be able to bring out this manufacturing. We have the Industrial Research Institute that is one of the organ of it, we have the Building Research Institute. These are geared towards this manufacturing. They also look at the local need and then try to create things to suit that. So I would like to say that there is a body there already, except that, we haven't publicised their work and marketing them.

i11-q13 What is responsible for they not being highly recognised?

i11-a13 It is both societal and governmental factors. We are in a society which would only want to go straight to already developed systems instead of looking at our own situations and need and then creating systems to suit us, we are not interested in going through research and coming up with products that would be beneficial to us, but we want to import and adapt to the system to our need.

i11-q14 What other tasks would you expect this body to accomplish?

i11-a14 This body should look at using locally available raw materials in the manufacture of whatever system they want to use to satisfy local need.

Interview 12- (i12)

Name of interviewee: [Name withheld]

Position of interviewee: Rector

Name of Institution: Ho Polytechnic

Date of interview: 10/09/2012

Q&A -- i12

i12-q1 This is an institution of technology; could you please give a brief account of the general of programmes and courses you offer in engineering. Specific details are not required.

i12- a1 This is an institution of technology and we offer courses in engineering, applied science and form of applied arts. In engineering, we offer courses in Civil Engineering, Building Technology, Mechanical Engineering and Electrical and Electronic Engineering. Some of these we offer to the HND level, some to the Bachelor of Technology level and others at lower levels of Pre-HND levels.

i12-q2 What was the mandate for setting up the Institution?

i12-a2 Generally, we are supposed to train middle-level manpower that would help develop this country through technology. But by our current Act, Act 745 of 2007, we have some leeway also to train some few capable people to as high as Doctor of Technology level; that is after the HND, you can progress to do Bachelor of Technology, Master of Technology and the D-Tech. We haven't yet gotten to the stage of the Masters and D-Tech levels, but, we have begun training some people at the Bachelor of Technology level. Yes, we are mandated to train people to fill that middle gap to solve the national's technological problems.

i12-q3 Do you offer any programmes in manufacturing, such as Manufacturing Engineering or any type of programmes or modules?

i12-a3 I wouldn't say yes, because when you look at our programmes typically, they are not into manufacturing engineering, even though somewhere along the line, some of the students manufacture some things that help them to acquire their degrees and diplomas. But typically, we are not into manufacturing engineering.

i12-q4 What factors determine the programmes you offer, are they job prospects, students' aptitude and qualification?

i12-a4 In the first place I would say national need. What are the needs of our country? From time-to-time workshops are organised, the authorities and stakeholders sit down and determine the way for the need of our society. That is main reason for which the polytechnics

are set up and they are the driving force for the programme that we offer. See that at a point, even though we are suppose to be an institution of technology, sometime, because of the need, we train other people who into Fashion, others into Hotel and Catering Management. We train people in Accountancy and Business, depending on the need of the country at any particular time. So it is societal need, national need that mostly dictates our programmes.

i12-q5 How frequently do you review your syllabus?

i12-a5 We are suppose to review our syllabuses every three years, but because of the huge capital involved in doing it, sometimes it can delay about a year or two, but mostly after five years, four years, we to review our syllabuses. The review of the syllabus is prompted by changes in technology worldwide. As the world is changing, as technology is changing, we have to get our students updated.

i12-q6 Do you train your students to suit international standards or for the local economy or both?

i12-a6 When you go round this globe, you will find our polytechnic students everywhere. I do get requests from all over the world asking us to comment on some students who are applying to jobs at various places. And sometimes, they ask of the syllabus we use to train them to adjudge whether they are capable. Yes, we train our students to meet all sorts of standards

including international standards, even though we use them mostly locally.

i12-q7 Do some of your engineering students' final year project focus on improving traditional production methods like pottery, *kente* weaving and so on?

i12-a7 Our engineering students in the final year, they pick up projects, designing all sorts of things, mostly prototypes. I know some of our mechanical engineering students who have developed some prototype vehicle. Recently, some of our students went into robotics; robotics is trying to develop some of those things to be used in the factory where human hands might be too dangerous to be used. But if you look at it, it is not originally geared towards improving traditional production method, but then, along the way, it comes in handy. Currently, when you go into this arts and craft, we are only now about to introduce course in the Visual Arts and Industrial Arts. When those ones come board, for sure, we will be doing things that will improve traditional production methods.

i12-q8 How are students' projects relayed to the local industry?

i12-a8 I would say we are a bit lagging behind in this aspect where results from our student projects get relayed quickly to industry. We would have liked it to be better relayed than it is now, the problem being that, in the first place, the industries, I would say, don't seem interested in what our students are doing, because, they have the notion that the polytechnic students are

not up to the scratch, but then, one thing is sure; that when these industries employ our students, it is then that they get to realise that most of them are better at the art and craft of whatever they want than those who come there with university degrees. These days, we are getting attention from industry trying to help us organise workshops and conferences where these project results will be relayed to industry and other stakeholders who are the consumes of our products. Like, we tried to mount this Polytechnic Research Conference and these are some of the avenues for us to relay the research that students do with their supervisors to the general public.

i12-q9 Is your staff strength adequate to transfer the requisite knowledge for a manufacturing programme if you are introducing it?

i12-a9 I wouldn't say yes, because some of these would need specific skills to deliver. We are people who are trained as general mechanical Engineers, Electrical Engineers, and so on. So when it comes to a programme that has to do with manufacturing in itself, I would not say our staff strength is adequate. There are few of them who could handle it, but we could not just go ahead to mount the programme without reengineering the current staff we have, or recruiting firsthand to come and help us.

i12-q10 Looking at the technology needed by the local industry in Ghana, how should such technologies be obtained?

i12-a10 We believe partnership with industry will help a lot. When we sit as Instructors, as Teachers, as Lecturers, and develop ideas and just put them into practise without seeking industry's input, we might not be able to develop things that will solve industry's problems. That is why we say, if the industry would be involved at the design stage, or come to us, with a catalogue of their problems; these are the sort of things we think should look out for us, then by that package, when we put ideas and thoughts together we would be able to develop technologies that are targeted to problem oriented research so that the industry would benefit directly from the technologies that we develop.

i12-q11 Which areas of technology would you suggest should attract a strong focus of attention?

i12-a11 Right now when you look at our nation, we are all into some form of product development, product manufacturing sort of. I think this is where our energy should be directed. Most of the time, we go outside to this developing countries; China, India, especially, to bring in finished products some of which don't meet the standards of things that we need in this country. So if we are able to put more attention to this manufacturing technology, it will go a long way to help us solve a whole of problems, so that the huge sums of foreign money that we put into the pockets of these other countries will help develop our own economy. So I think much attention should be place on this manufacturing technology and industry.

i12-q12 Looking at the manufacturing situation in Ghana, would you consider it worthwhile for Ghana to have a body set up specifically to see to manufacturing technology for local industry, the same way as we have Cocobod taking care of cocoa research, production and quality?

i12-a12 We have a whole lot of bodies already in place. For example, when you go to the Council for Scientific and Industrial Research, the CSIS, they have all sorts of mandates. We have this Food and Drugs Board, who are there to look at a whole of things. Maybe, the only thing we need to do now is to have an oversight body to take care of all these individual institutions and harness whatever they are doing as individual committees or councils, otherwise, establishing all these things without coordinating them, without harnessing their energies or their efforts would not lead us anywhere. Cocobod's case is a different issue; because when you look at the way they consume cocoa in Ghana, but then, if we should look at other manufacturing in Ghana, it would be just duplicating a whole lot issues [bodies] which might not help us a lot. I know that most of these manufacturing companies have bodies that take care of whatever they do, so whether Ghana needs to set up another body specifically to see to this manufacturing technology is open to a whole lot of debate, but personally, I think we only need an oversight body to coordinate the activities of all these various bodies.

i12-q13 What other tasks, apart from harnessing and coordinating, should such a body have?

i12-a13 When we are talking of manufacturing, yes, people are manufacturing, but standards are never met. So if such a body, even though we have Standards Board, should be equipped, whatever it takes, to establish and maintain standards; without that, we will be running into all sorts of problems. If you take the alcoholic industry, for example in Ghana, every single day new products are coming out and they these things are being endorsed by the Food and Drugs Board or the Standard Board, but every other day, we hear of problems here and there, because of those drinks. People talk of the substandard items that are on the shelf all over the place. So I believe this oversight body should be tasked more to look at standards. Once the standards are taken care of, you see, we Ghanaians believe in standards, that is why things that come from the Western countries, even though they sell at three times things that come our own country and from the South-East Asian countries, they are still patronised. Somebody would want to buy an item that is very costly and will last or is of very high quality than buying three of a low standards product. [Standards]

i12-q14 Is there any question I should have asked you want to ask?

i12-a14 When talking about developing a sustainable manufacturing technology in Ghana, I think the opening question should have been; do we have any

manufacturing technology system at all? And I think the answer to that to me is no. so we have to start to develop a manufacturing system in the first place before we think about its sustainability.

Interview 13 (i13) – Interview responses sent by e-mail

Name of interviewee: [Name withheld]

Position of interviewee: Research Coordinator

Name of Institution/Organisation: Council for Technical and Vocational Education and Training (COTVET)

Date of Respondent's email: 29/08/2012

Q&A – i13

i13-q1 Could you please briefly say what the mandate of COTVET is; what is its history and what does it do?

i13-a1 The Council for Technical and Vocational Education and Training (COTVET) was established by an Act of Parliament (Act 718, 2006) to coordinate and oversee all aspects of Technical and Vocational Education and Training (TVET) and also formulate national policies for skills development across the broad spectrum of pre-tertiary, tertiary, formal and informal sectors.

The Functions of the Council are to:

- formulate national policies for skills development across the broad spectrum of pre-tertiary and tertiary education, formal, informal and non-formal;
- harmonize and supervise the activities of private and public providers of technical and vocational education and training, including the informal sector;

- rationalize the assessment and certification system in technical, vocational education and training;
- take measures to ensure quality in delivery of and equity in access to technical and vocational education and training;
- maintain a national database on technical, vocational education and training;
- facilitate research and development in the technical and vocational education and training system;
- source funding to support technical and vocational education and training activities

VISION:

- To coordinate and oversee a TVET system that produces globally competitive workforce through quality oriented and demand-driven learning for national development

MISSION:

- To be a world-class leader in coordinating skills development.

Refer also to the 2010 NESAR report and the Anamoah Mensah report

i13-q2 Considering one of your functions as coordinating and supervising technical and vocational education providers, are you able to make inputs into their curricula?

i13-a2 **Ans.:** YES. We are able to influence their curricula by making recommendations based on informed research

i13-q3 You would understand exactly how important technical education is; could you please describe how this importance is reflected in the Ghanaian society from

political decisions to the educational setup right through to industry and research institutions?

i13-a3 The coloured backgrounds in the table below shows the TVET oriented occupations in the Ghanaian economy and even more. This shows the importance of TVET in Ghana.

MAIN OCCUPATION	**URBAN**	**RURAL**	**ALL**
Legislators and Managers	1.1	0.1	0.4
Professionals	5.7	1.3	2.8
Technicians and Associate Professionals	4.2	0.9	2.0
Clerks	2.9	0.2	1.1
Service/Sales workers	25.9	6.3	13.0
Agric/ Fishery workers	18.6	74.2	55.1
Craft and related trades workers	21.7	9.1	13.4
Plant and Machine operators	6.4	1.6	3.2
Elementary occupations	11.4	6.2	8.0
Armed forces/ security personnel	2.2	0.3	0.9
All	**100.0**	**100.0**	**100.0**

i13-q4 Compared to the non-technical education (academic) what are the entry requirements for the

technical/vocational education and training at the various levels?

i13-a4 The entry requirements into Technical and Vocational institutions are the same. The issue here is the private second cycle institutions who lowers the requirement mainly for business purposes. You can further check with a cross section of institutions in the sector

i13-q5 Within the technical education framework, how relevant has the subject of manufacturing been considered?

i13-a5 Manufacturing is very important and considered at all levels.

i13-q6 It is argued, within the context of this study that manufacturing technology is the means by which all manufacturing and production are made possible. Could you briefly describe this realisation in the Ghanaian context and how Ghana is making the effort towards manufacturing some of its needed technologies?

i13-a6 Refer to the Science, Technology and Innovation Policy Review document developed by UNCTAD and the ISSP of the Industrial Policy of Ghana.

i13-q7 Using allocation of funds as a measurement for national importance on technological build up; what percentage of educational budget is given for technical/vocation training, and how much of this is set for manufacturing technology?

i13-a7 Refer to EMIS 2010, Data

i13-q8 Ghana is very much reliant on importation of technical solutions rather than seeking to address some of its technological needs through research and manufacturing; from your experience as Executive Director, what, in your opinion, accounts for the neglect in developing the Ghanaian indigenous manufacturing, thus, leading to this high level of dependency?

i13-a8 First of all, the sector cannot be considered as being neglected but having challenges. Several efforts have been made to shore up this and one of such is the Industrial Policy and its ISSP. Besides this, there are a number Research centres in the country whose findings have been constantly left on the shelves.

Also, I don't agree with you tagging Ghana as a dependent state because the imbalances in our economy does not amount to dependency

i13-q9 Would you consider it worthwhile for Ghana to have an overruling body to see to the manufacturing technology aimed at technology manufacturing for local production/manufacturing the same way we have Cocobod for cocoa production?

i13-a9 I would not recommend that since we have a Ministry in charge of Environment, Science and Technology. Rather the departments of Science and Technology should have a unit or committee to manage that.

i13-q10 Who would you please recommend I speak to again?

i13-a10 Speak to some Directors at MOTI, MEST and some research centres.

Interview 14 (i14) – Interview responses sent by e-amil

Name of interviewee: [Name withheld]

Position of interviewee: Research Coordinator

Name of Institution/Organisation: Council for Technical and Vocational Education and Training (COTVET)

Date of Respondent's email: 16/10/2012

Q&A – i14

i14-q1 What does AGI do?

i14-a1 The Association of Ghana Industries (AGI) is a business association with primary focus on: (i) Policy advocacy (ii) Business development (iii) Networking

i14-q2 The world is rapidly moving away from trading in primary goods and moving more towards demand for value-added products. How does AGI currently augment the acquisition of technology for value-added production of local primary products?

i14-a2 Whilst multinationals/large firms employ state-of-the-art technology in producing, most medium and small-scaled enterprises (SMEs) use aged and obsolete technology.

i14-q3 What are the main types of technologies used by majority of members of the Association?

i14-a3 Two main types of technologies are used namely, (i) state-of-the-art and (ii) out-of-date.

i14-q4 How are most of these technologies obtained? Are they manufactured locally or imported from other economies?

i14-a4 Most of these technologies are imported.

i14-q5 What indicators does the Association use to measure performance within the local industry setup? Do you use solely the cashbook profit and loss balance sheet or you also measure by amount of investment in technological acquisition?

i14-a5 The Association uses growth in sales and profit as well as technologies used by firms.

i14-q6 Has AGI, as a body, attempted to focus on addressing the issue of members' technological needs? In which way has this focus been?

i14-a6 Yes. The AGI signed an MOU with Kwame Nkrumah University of Science and Technology (KNUST) in 2006 to collaborate with industry to develop appropriate technologies for local manufacturers.

i14-q7 As Executive Director of the Association, would you consider your members willing and able to pay for locally manufactured technologies which may not be perfect from the start, but would be improved upon with time?

i14-a7 Yes, most micro and small-scaled firms (which constitute over 50% of manufacturers in Ghana) would be willing to pay and use locally-manufactured technologies.

i14-q8 Would you consider it worthwhile for Ghana to have an established body solely for the creation and development of technology for the need of local industries, just as there is Cocobod set up for cocoa production and research?

i14-a8 Yes. There is a need to have a body that coordinates the development of technologies and ensuring effective transfer of these technologies to industries. Such a body could ensure the empowerment of various technology development institutes.

i14-q9 What other tasks would you expect such a body to accomplish?

i14-a9 Such a body needs to continuously conduct research in order for it to come out with forward-looking technologies for local manufacturers.

i14-q10 Please ask any question(s) I should have asked but did not ask?

i14-a10 You can talk to Ghana Regional Appropriate Technology & industrial Science (GRATIS) and KNUS